Application for Locally Adopted Energy Standards by the Marin County in Accordance With Section 10-106 of the California Code of Regulations, Title 24, Part 1

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Table of Contents

1.0 Executive Summary for the Marin County Green Building Ordinance

The Marin County Council adopted their revised Green Building Ordinance on February 9, 2010 including review and approval of energy cost-effectiveness based on the *Marin County Green Building Ordinance Energy Cost-Effectiveness Study* (dated 12/10/09 and contained in the Appendix). The new ordinance is scheduled to take effect under the state's 2008 Building Energy Efficiency Standards on or around April 15, 2010. Gabel Associates has researched and reviewed the feasibility and energy cost-effectiveness of permit applicants exceeding the 2008 Standards in order to meet the minimum energy efficiency requirements of the proposed ordinance.

Overall Scope of the Marin County Green Building Ordinance

New ordinance or revision to previous ordinance?	**Revised Ordinance**
Projected Effective Date:	**April 15, 2010**
Green building or stand-alone energy ordinance?	**Green Building Ordinance**
Do minimum energy requirements increase after initial effective date?	**No**
Occupancies covered?	**Residential and Nonresidential Buildings**
Energy requirements apply to new construction, additions, alterations?	**New Construction, Additions and Alterations (Renovations)**
Special or unusual energy requirements?	**New Single Family Dwelling Units ≥ 4,000 sq.ft.**
Third party verification?	**GreenPoint Rater for Residential Buildings; LEED AP for Nonresidential Buildings**
Implementation details in the ordinance or in a separate document?	**No**

Key Features of the Marin County Ordinance By Occupancy Type

Occupancy Type	General Requirements	Minimum Energy Requirement
Single Family and Two-Family Buildings:	**2010 GreenPoint Rated**	
500 - 2,499 sq.ft. (per unit)	75 points	15% Better-than-Title 24
2,500 - 3,999 sq.ft. (per unit)	100 points	15% Better-than-Title 24
4,000 - 5,499 sq.ft. (per unit)	125 points	20% Better-than-Title 24
5,500 - 6,999 sq.ft. (per unit)	150 points	30% Better-than-Title 24
7,000+ sq.ft. (per unit)	200 points	Net Zero Energy
Single Family and Two-Family Buildings:	**2010 GreenPoint Rated for Existing Homes**	
Any Additions or Alterations which meet Title 24 with Existing + Addition + Alteration Method	(varies per Marin County Green Building Ordinance Table A)	15% Better-than-Title 24
$300,000+ valuation or 1,000+ sq.ft.	50 points	20% improvement in HERS II or BPI home performance audit; or a HERS II score of ≤ 100
Multi-Family Buildings:	**2010 GreenPoint Rated**	
< 1,000 sq.ft. / average unit	60 points	15% Better-than-Title 24
1,000+ sq.ft. / average unit	75 points	15% Better-than-Title 24
Nonresidential Buildings and Nonresidential Additions:	**LEED Version 3.0**	
2,000 - 4,999 sq.ft.	Checklist + Prerequisites	2008 Title 24 Standards
5,000 - 49,999 sq.ft.	LEED Silver	15% Better-than-Title 24
50,000+ sq.ft.	LEED Gold	15% Better-than-Title 24

TABLE A: GREEN BUILDING STANDARDS FOR COMPLIANCE FOR RESIDENTIAL CONSTRUCTION AND RENOVATION

Covered Project	Green Building Rating System	Minimum Compliance Threshold	Energy Budget Below CA Title 24 Part 6	Verification
Single-Family or Two-Family Residential: New construction				
500-2,499 sq. ft. (per unit)	GPR New Home	75 points	15%	Green Point Rated[1]
2,500-3,999 sq. ft. (per unit)	GPR New Home	100 points	15%	Green Point Rated[1]
4,000-5,499 sq. ft. (per unit)	GPR New Home	125 points	20%	Green Point Rated[1]
5,500-6,999 sq. ft. (per unit)	GPR New Home	150 points	30%	Green Point Rated[1]
7,000+ sq. ft. (per unit)	GPR New Home	200 points	Net zero energy	Green Point Rated[1]
Single-Family or Two-Family Residential: Renovations (including additions to existing buildings)				
Less than $50,000 valuation	n/a	Insulate exposed hot water pipes; Install radiant barrier when reroofing and removing sheathing		City building inspector
$50,000-$99,999 valuation or less than 500 sq. ft.[3]	GPR Existing Home	Checklist submittal and completion of a HERSII or BPI home performance audit		City plan check
$100,000-$149,999 valuation or 500-749 sq. ft.[3]	GPR Existing Home – Elements	25 points		GreenPoint Rater[2]
$150,000-$299,999 valuation or 750-999 sq. ft.[3]	GPR Existing Home – Elements	35 points		GreenPoint Rater[2]
$300,000+ valuation or 1,000+ sq. ft.[3]	GPR Existing Home – Whole House	50 points + 20% improvement in HERSII or BPI home performance audit results or a minimum HERSII score of 100		GreenPoint Rated[2]
Multi-Family Residential: New Construction				
Less than 1,000 sq. ft. average unit size	GPR Multi-Family	60 points	15%	GreenPoint Rated[1]
1,000+ sq. ft. average unit size	GPR Multi-Family	75 points	15%	GreenPoint Rated[1]

[1] Project verification by GreenPoint Rater and certification by Build It Green

[2] Project verification by GreenPoint Rater

[3] Project valuation will be the primary determinate in establishing the Minimum Compliance Threshold for the project, with use of project size range when valuation is uncertain or in the opinion of the building official does not accurately reflect the project scope.

TABLE B: GREEN BUILDING STANDARDS FOR COMPLIANCE FOR NONRESIDENTIAL CONSTRUCTION AND RENOVATION

Covered Project	Green Building Rating System	Minimum Compliance Threshold	Energy Budget Below CA Title 24 Part 6	Verification
New construction (including additions to existing buildings)				
2,000-4,999 sq. ft.	LEED® New Construction or Core & Shell	Checklist submittal + compliance with Prerequisites		LEED® AP with additional GreenPoint Rater or BPI Certification
5,000-49,999 sq. ft.	LEED® New Construction or Core & Shell	LEED® Silver	15%	LEED® AP with additional GreenPoint Rater or BPI Certification
50,000+ sq. ft.	LEED® New Construction or Core & Shell	LEED® Gold	15%	GBCI Certified
Renovations				
Less than $500,000 valuation or 500-4,999 sq. ft. [3]	LEED® Commercial Interiors or Operations & Maintenance	**Voluntary** compliance with the following Prerequisites: WE P1 (Water Efficiency–Baseline Requirements only)[4] EA P3 (Fundamental Refrigerant Management) for renovations of ≥50% of the building interior area **Voluntary** compliance with the following Credits: EA C1.3 (Optimize Energy Performance – HVAC) for renovations of ≥50% of the building interior area		None
$500,000 - $5 million valuation or 5,000-24,999 sq. ft. [3]	LEED® Commercial Interiors or Operations & Maintenance	Same as above, but Required.		City building inspector
Greater than $5 million valuation or 25,000+ sq. ft. [3]	LEED® Commercial Interiors or Operations & Maintenance	LEED® Silver		LEED® AP with additional GreenPoint Rater or BPI Certification

[3] Project valuation will be the primary determinate in establishing the Minimum Compliance Threshold for the project, with use of project size range when valuation is uncertain or in the opinion of the building official does not accurately reflect the project scope.

[4] Applicable only to fixtures within area of renovation or restrooms associated with area of renovation.

SOLAR ELECTRIC SYSTEMS

A solar photovoltaic (PV) energy system may be used to meet the Energy Budget Below CA Title 24 Part 6 requirements of this resolution which exceed 15%. To qualify for energy credits, the PV energy system must be capable of generating electricity from sunlight, supply the electricity directly to the building, and the system is connected, through a reversible meter, to the utility grid. The installation of any qualifying PV energy system must meet all installation criteria contained in the California Energy Commission's Guidebook "Eligibility Criteria and Conditions for Incentives for Solar Energy Systems." The methodology used to calculate the energy equivalent to the PV credit shall be the CECPV Calculator, using the most recent version, provided by the California Energy Commission.

INCENTIVES

A City Green Building emblem for construction signage shall be provided for all residential and non-residential projects that obtain a GreenPoint or LEED rating.

The following incentives shall be provided for residential projects that achieve at least 100 GreenPoints or non-residential projects that achieve at least a LEED® Gold rating:

1. Expedited building permit plan check (typically 2-week turnaround)
2. Reimbursement for the cost of the GreenPoint Rater services (residential projects only, up to a maximum of $1,000)
3. Provision of a bronze plaque for building mounting, identifying the project as a green building

EXCEPTIONS

The following shall not be included as Covered Projects:

1. Buildings which are temporary,
2. Building area which is not or is not intended to be conditioned space, and
3. Any requirement which would impair the historic integrity of any building listed on a local, state or federal register of historic structures.

The following shall not be included in project valuation:

1. Improvements primarily intended for seismic upgrades or required disabled access,
2. Building replacement due to catastrophic loss due to flood or earthquake damage, and
3. Installation of renewable energy systems.

2.0 Text of Marin County Green Building Ordinance and Supporting Documents

This section includes copies of the following documents:

- Marin County Green Building Staff Report
- Marin County Green Building Ordinance
- Marin County Green Building Ordinance Exhibit “A”
- Marin County Green Building Requirements

MARIN COUNTY BOARD OF SUPERVISORS

ORDINANCE NO. ____

AN ORDINANCE ADOPTING AMENDMENTS TO MARIN COUNTY CODE TITLE 19 (BUILDING CODE)

*** ***

SECTION I. FINDINGS

The County of Marin Board of Supervisors ordains as follows:

WHEREAS, the Marin County Community Development Agency initiated proposed amendments to Marin County Code Title 19 (Building Code). The Building Code includes building and energy efficiency regulations that apply to the unincorporated areas of Marin County. The proposed amendments include, but are not limited to: (1) the addition of green building requirements for new single family and duplex structures, remodels to residential structures, new multi-family projects or additions, new non-residential buildings or additions, and remodeling to non-residential structures; and (2) modifying the existing Marin County Single Family Dwelling Energy Efficiency standards to be consistent with the 2008 California Building Energy Efficiency Standards, require that homes over 7,000 square feet achieve zero net energy use, and expand requirements to include new multi-family projects, and non-residential projects over 5,000 square feet; and

WHEREAS, the proposed Marin County Code Title 19 changes implement the Marin Countywide Plan (CWP) programs AIR-4.a (reduce greenhouse gas emissions resulting from energy use in buildings), AIR-4.e. (reduce County government contributions to greenhouse gas emissions), EN-1.b (adopt energy efficiency standards for new and remodeled buildings), EN-1.c (implement the single-family dwelling energy efficiency ordinance), EN-1.d (explore energy efficiency standards for existing buildings), EN-1.f (explore regional collaboration, financing, and other incentives for programs that promote sustainable energy practices), EN-1.j (reduce energy use in County facilities), EN-2.d (facilitate renewable energy technologies and design), EN-3.a (require green building practices for residential development), EN-3.b (require green building practices for non-residential development), EN-3.f (facilitate green building practices), and WR-3.a. (support water conservation efforts); and

WHEREAS, the Marin County Board of Supervisors certified a Final Environmental Impact Report (EIR) for the CWP prior to the adoption of the CWP. The certified EIR adequately evaluated the Building Code, which functions as an implementing program to the CWP. The CWP and CWP certified EIR adequately describes the current approval for the purposes of CEQA. A subsequent or supplemental EIR is not required pursuant to CEQA Guidelines Section 15162 because the proposed project does not include substantial changes involving new or more severe significant environmental effects, nor does the proposal involve new information that was not known at the time the EIR for the CWP was certified.

WHEREAS, the 2007 Marin County Re-Inventory of Greenhouse Gas Emissions determined that the operation of residential and non-residential buildings within the County generates 31% of the city's total annual greenhouse gas emissions; and

WHEREAS, the 2006 Marin County Greenhouse Gas Reduction Plan identifies reducing building energy use as one of the most effective means of meeting the adopted goal of reducing

the production of greenhouse gases 15-20% below 1990 levels by the year 2020 for internal government and 15% countywide; and

WHEREAS, the California Global Warming Solutions Act of 2006, known as AB 32, established a statewide goal of reducing greenhouse gas emissions to 1990 levels by 2020 and to a level 80% below 1990 levels by 2050, and directs the California Air Resources Board to develop a strategy to achieve such reductions; and

WHEREAS, the California Air Resources Board adopted its Climate Change Scoping Plan on December 12, 2008, which identified the imposition of mandatory green building techniques as achieving 15% of the AB 32 greenhouse gas reduction goal for 2020; and

WHEREAS, the California Public Utilities Commission has adopted a goal of 40% improved energy efficiency in all buildings by 2020; and

WHEREAS, the San Francisco Bay Conservation and Development Commission has indicated that the sea level of the San Francisco Bay has increased 8 inches over the past century and projects that sea level will rise between 20 and 55 inches by 2100, which will inundate properties currently valued at over $48 billion dollars and over 700 miles of state and local roadways and will require the installation of seawalls and levee increases costing over $1 billion; and

WHEREAS, the United Nations Intergovernmental Panel on Climate Change has warned that failure to address the causes of global climate change within the next few years will result in significant sea level increases and frequency of wildland fires and reduced freshwater resources, which will significantly increase the cost of providing local governmental services and protecting public infrastructure; and

WHEREAS, the United States Environmental Protection Agency (EPA) states that the construction and operation of buildings in the United States collectively account for 39% of total energy use, 68% of total electricity consumption, 12% of total freshwater consumption, 40% of all raw materials used, and 38% of total carbon dioxide emissions; and

WHEREAS, the total energy consumption by residential dwelling units in Marin County increased from 619 million kWh to 734 million kWh (a 19% increase) from 1995 to 2000; and

WHEREAS, according to the California Health and Safety Code Sections 18938, 17958 and Section 17958.5 a local government may establish more stringent building standards than the California Building Codes Standards if they are reasonably necessary due to local climatic, geological or topographical conditions; and

WHEREAS, California Assembly Bill 210 states that a city is authorized to change or modify green building standards if the California Building Standards Commission determines such changes are reasonably necessary because of local climatic, geological or topographical conditions; and

WHEREAS, the Public Resources Code Section 25402.1(h)(2) states that a local enforcement agency may adopt more restrictive energy standards when they are cost-effective and approved by the California Energy Commission; and

WHEREAS, green building is a practice of design, construction and maintenance techniques that have been demonstrated to have a significant positive effect on energy, water and resource conservation, waste management and pollution generation and on the health and productivity of building occupants over the life of the building; and

WHEREAS, green building benefits are spread throughout the systems and features of the building. Green buildings can include, among other things, the use of certified sustainable wood products, extensive use of high-recycled-content products; orientation and design of a building to reduce the demand on the heating, ventilating, and air conditioning systems; the use of heating, ventilating, and air conditioning systems that provide energy efficiency and improved air quality; enhancement of indoor air quality by selection and use of construction materials that do not emit chemicals that are toxic or irritating to building occupants; the use of water conserving methods and equipment; and installation of alternative energy methods for supplemental energy production; and

WHEREAS, in recent years, green building design, construction and operational techniques have become increasingly widespread. Many homeowners, businesses, and building professionals have voluntarily sought to incorporate green building techniques into their projects. A number of local and national systems have been developed to serve as guides and rating systems for green building practices. The U.S. Green Building Council, developer of the Leadership in Energy and Environmental Design (LEED®) Green Building Rating Systems, has become a leader in promoting and guiding green building, particularly for non-residential structures. Build It Green has developed the New Home, Existing Home and Multi-Family Green Building Guidelines and associated GreenPoint Calculators, which have been adopted for use in approximately 70 Bay Area jurisdictions; and

WHEREAS, construction of buildings in accordance with the GreenPoint Rated and LEED® rating systems results in average energy savings of about 20% compared with buildings constructed in accordance with current minimum standards of the state building code; and

WHEREAS, representatives of all municipalities within Marin County and of the county government participated in a collaborative effort known as the Marin Green Building, Energy Retrofit and Solar Transformation (BERST) Task Force, held meetings on June 11, July 13, September 29 and 30, and November 19, 2009 and endorsed a model green building ordinance recommended by a Technical Advisory Committee comprised of over 50 experts in the fields of architecture, building construction, green building, building energy systems, energy conservation, water conservation, building inspection, planning and real estate over the course of 11 meetings; and

WHEREAS, the ordinance was introduced at a regular meeting of the Board of Supervisors on the 26th day of January, 2010, and adopted by the Board of Supervisors of the County of Marin, State of California, on the 9th day of February 2010; and

WHEREAS, the proposed amendments meet the requirements of California Health and Safety Code Sections 18938, 17958, and 17958.5, California Assembly Bill 210 and Public Resources Code Section 25402.1(h)(2).

SECTION II: AMENDMENTS TO TITLE 22

NOW, THEREFORE, BE IT RESOLVED that the Marin County Board of Supervisors hereby adopts the amendments to Marin County Code Title 19 (Building Code) as depicted in Exhibit "A" of this Ordinance. The requirements of Marin County Code Chapter 19.04 shall govern the applicability of the approved amendments to existing projects that are in the development review process.

SECTION III: EFFECTIVE DATE

This Ordinance shall be and is hereby declared to be in full force and effect as of sixty (60) days from and after the date of its passage and until the Ordinance provisions are approved by the California Energy Commission, whichever comes later. The Ordinance shall be published once before the expiration date of fifteen (15) days after its passage, with the names of the Supervisors voting for and against the same in the Marin Independent Journal, a newspaper of general circulation published in the County of Marin.

SECTION IV: VOTE

PASSED AND ADOPTED at a regular meeting of the Board of Supervisors of the County of Marin held on this 9th day of February by the following vote:

AYES:

NOES:

ABSENT:

_____
PRESIDENT, BOARD OF SUPERVISORS

ATTEST:

_____
CLERK

EXHIBIT "A"

PROPOSED TEXT AMENDMENTS
MARIN COUNTY BUILDING CODE (TITLE 19)

SECTION I Chapter 19.04 of the Marin County Code is herby amended to read as follows:

19.04.100 Energy Efficiency Standards for Single Family Dwellings, Multi-Family Residential and Commercial Construction.

A. Definitions. For the purposes of this section, the following definitions shall apply:
   1. "Current Standards." The 2008 California Building Energy Efficiency Standards or subsequently adopted state energy standards, whichever is applicable at the time of the building permit application, including California Code of Regulations, Title 24, Parts 1 and 6.
   2. "Solar Photovoltaic Energy System." A photovoltaic solar collector or other photovoltaic solar energy device that has a primary purpose of providing for the collection and distribution of solar energy for the generation of alternating current rated peak electricity. The installation of any solar photovoltaic energy system must meet all installation criteria of the current edition of the California Electrical Code and the California Energy Commission *Guidebook Eligibility Criteria and Conditions for Incentives for Solar Energy Systems Senate Bill* 1.
   3. "Photovoltaic (PV) Credit." A TDV Energy credit that may be used to achieve compliance with the requirements of this section. This credit is available if the solar photovoltaic energy system is capable of generating electricity from sunlight, supplying the electricity directly to the building, and the system is connected, through a reversible meter, to the utility grid. The methodology used to calculate the energy equivalent to the photovoltaic credit shall be the CECPV Calculator, using the most recent version prior to the permit application date, which may be found at the following web site: http://www.gosolarcalifornia.ca.gov/nshpcalculator/download_calculator.html
   4. "Alternative Proposed Design Credit." An energy credit for alternative energy system designs that may be used to achieve compliance with the requirements of this section subject to approval by the Chief Building Official and the Director of the Marin County Community Development Agency. Alternative energy system designs may include, but are not limited to, any renewable energy system which is not a solar photovoltaic system and any energy-efficiency measures not included in the Title 24 performance analysis which significantly exceed current building practice or applicable minimum state or federal efficiency standards. The permit applicant must submit calculations to document, explain and justify the amount of the credit claimed.
   5. "Net Zero Energy." A building that has a net annual Time Dependent Valued (TDV) Energy Consumption, as defined by Title 24 of the California Code of Regulations, of zero, accounting for both energy consumption and the use of on-site renewable energy production.

B. Covered Projects. The provisions of this section shall apply to the following types of building projects for which a building permit is applied for and accepted as complete by the Building and Safety Division after the effective date of this section:
   1. New single family dwellings resulting in a total dwelling size of 500 square feet or greater of total conditioned floor area.

2. Additions to single family dwellings resulting in a total dwelling size of 1,500 square feet or greater of total conditioned floor area and where Title 24 energy performance documentation is submitted which uses the Existing + Addition or Existing + Addition + Alteration calculation method.
3. Substantial remodels, as defined in this code, to single family dwellings resulting in a total dwelling size of 1,500 square feet or greater of total conditioned floor area and where Title 24 energy performance documentation is submitted which uses the Existing + Alteration or Existing + Addition + Alteration calculation method. (For the purposes of this section, the terms "remodel" and "alteration" are synonymous.)
4. New multi-family residential construction.
5. New commercial construction resulting in 5,000 square feet or greater of total conditioned floor area.

C. Exemptions. Affordable housing dwellings approved by the Agency Director are exempted from the requirements of this ordinance.

D. Compliance. A building permit subject to the provisions of this section will not be issued by the Building and Safety Division unless the energy compliance documentation submitted with the permit application meets the requirements of this section. A certificate of occupancy will not be granted until a Certificate of Field Verification and Diagnostic Testing (CF-4R) for the permitted project is submitted to the Building and Safety Division when applicable. A certificate of occupancy will not be granted unless the work authorized under a permit has been constructed in accordance with the approved plans, conditions of approvals and requirements of this section.

E. General Requirements. All covered projects subject to the provisions of this section shall exceed the Current Standards using the performance approach by the percentage (%) indicated in the Compliance Table corresponding to the dwelling's resultant total conditioned floor area.

Residential Compliance Table	
Dwelling Size [1] (Total Conditioned Floor Area)	**Buildings Must Exceed the Current Standards by:**
500 – 3,999 SF	*15%*
4,000 – 5,499 SF	*20%*
5,500 – 6,499 SF	*30%*
7,000+	*Net zero energy*

Note 1: All additions and/or substantial remodels in dwellings with a total conditioned floor area of 1,500 square feet or greater, and where compliance with the Title 24 Standards uses the Existing + Addition + Alteration performance method, shall meet the requirements of the Compliance Table.

Multi-Family Residential Compliance Table	
Building Size (Total Conditioned Floor Area)	Buildings Must Exceed the Current Standards by:
All	*15%*

Commercial Compliance Table	
Building Size (Total Conditioned Floor Area)	Buildings Must Exceed the Current Standards by:
5,000+ sq. ft.	*15%*

1. New single family dwellings subject to the provisions of this section shall meet both of the following:
    a. Exceeding the Current Standards as specified in the Compliance Table, using the performance compliance approach; and,
    b. Meeting all other provisions applicable to low-rise residential buildings contained in the Current Standards.

2. Additions and/or alterations to single family dwellings subject to the provisions of this section shall meet one of the following requirements:
    a. The addition and /or alteration shall comply with subsection E.2.; or,
    b. The energy efficiency of the existing building shall be improved so that the existing building plus the addition and/or alteration meet the requirements listed in the Compliance Table.

3. A building project may use the solar PV Credit and/or the Alternative Proposed Design Credit to meet the requirements of subsection E.1. if the proposed building exceeds the Current Standards using the performance compliance approach by at least 15.0%.

4. In addition to the standard Title 24 report and when a permit applicant is applying for Solar PV Credit or an Alternative Proposed Design Credit, a special compliance and calculation form, which shall be available at the Community Development Agency, documenting compliance with the provisions of this section shall be submitted with the building permit application and included on all plan sets with the CF-1R.

5. HERS field verification and diagnostic testing. All buildings, additions, and remodels subject to the provisions of this section shall be field verified, by a certified HERS rater when required by these Local Standards. Verification shall be in accordance with protocols established in the Residential Field Verification and Diagnostic Testing Regulations Manual. A CF-4R, when required by the Current Standards, shall be submitted to the Building and Safety Division to demonstrate compliance prior to issuance of a certificate of occupancy.

F. Modifications. Whenever there are practical difficulties involved with carrying out the literal provisions of this Section; the Building Official, in consultation with the Community Development Agency Director, shall be authorized to grant modifications for individual cases, upon application by the owner or owner's representative, provided that the Building Official determine the requested modification is in compliance with the intent and purpose of this section.

19.04.110 Green Building Requirements.

Sections:

19.04.110 Purpose.

The purpose of this Chapter is to enhance the long-term public health and welfare by contributing to the overall reduction of greenhouse gas production and emissions and improving the environmental and economic health of the County through the efficient design, construction, operation, maintenance and deconstruction of buildings and site development by incorporating green building practices and materials. The green building provisions referenced in this Chapter are designed to achieve the following objectives:

1. Increase energy efficiency in buildings;
2. Encourage water and resource conservation;
3. Reduce waste generated by construction projects;
4. Reduce long-term building operating and maintenance costs; and
5. Improve indoor air quality and occupant health; and
6. Contribute to meeting the state and local commitments to reduce greenhouse gas production and emissions.

19.04.120 Applicability.

The provisions of this Chapter shall apply to all construction or development projects defined below as a "Covered Project."

19.04.130 Definitions.

For the purposes of interpreting this Chapter and the associated Standards for Compliance, the following terms are defined as follows. When the definitions below differ from those contained elsewhere in this Title, the provisions of this Chapter shall apply.

1. "Addition" means the addition of building square footage to an existing structure.
2. "BIG" means Build It Green, a non-profit organization which established and maintains the Green Point Rated system for evaluating and certifying residential green buildings and green building professionals.
3. "BPI" means the Building Performance Institute, a non-profit organization which provides training and certification of green building professionals.
4. "Building envelope" means the ensemble of exterior and demising partitions of a building and roof structure that enclose conditioned space.
5. "Compliance threshold" means the minimum number of points or rating level required to be achieved by a particular Covered Project as set forth by the Standards for Compliance outlined in Section 19.04.140.
6. "Conditioned space" means any area within a building or structure that is heated or cooled by any equipment.
7. "Covered project" means a development project for which one or more building permits are required for new construction or remodels as set forth by the Standards for Compliance outlined in Section 19.04.140.
8. "GBCI" means the Green Building Certification Institute, a non-profit organization which certifies green buildings and green building professionals under the LEED® rating system.
9. "Green building" means a comprehensive process of design and construction that employs techniques to increase the efficiency of resource use, including energy, water and building materials, while minimizing adverse impacts on human health and the natural environment.
10. "Green building checklist" means a checklist or rating sheet used for calculating a green building rating.
11. "Green building rating system" means a standardized rating system providing specific criteria to determine the level of compliance of building projects as set forth by the Standards for Compliance outlined in 19.04.140.
12. "GreenPoint Rated" means a residential building certified as complying with the green building rating systems developed by the Build It Green organization.
13. "GreenPoint Rater" means an individual certified by Build It Green as capable of evaluating and rating residential construction projects for compliance with the GreenPoint Rated green building rating systems.
14. "HERS" means the Home Energy Rating System adopted by the California Energy Commission.
15. "LEED®" means the "Leadership in Energy and Environmental Design" green building rating system developed by the U.S. Green Building Council.
16. "LEED® AP" means an individual who has been certified a LEED® Accredited Professional by the U.S. Green Building Council or the Green Building Certification Institute as capable of evaluating and rating construction projects for compliance with the LEED® green building rating systems.

17. "Net Zero Energy" means a building that has a net annual Time Dependent Valued (TDV) Energy Consumption, as defined by Title 24 of the California Code of Regulations, of zero, accounting for both energy consumption and the use of on-site renewable energy production.
18. "New construction" means the construction of a new or replacement residential dwelling unit or a new or expanded commercial building.
19. "Qualified green building rater" means an individual who has been trained and certified as a LEED® AP, GreenPoint Rater or has similar qualifications and certifications if acceptable to the Chief Building Official.
20. "Renovation" means any remodeling, modification or tenant improvement to an existing building that includes replacement or alteration of at least two of the following: heating/ventilating/air conditioning system, building envelope, hot water system or lighting system, but excluding improvements and project valuation related to seismic or disabled access, building replacement due to catastrophic loss due to flood or earthquake damage or installation of renewable energy systems. Renovation shall include any addition of conditioned space to an existing dwelling unit.
21. "USGBC" means the U.S. Green Building Council, a non-profit organization which established and maintains the LEED® rating systems for evaluating and certifying residential green buildings and green building professionals.

19.04.140 Standards for Compliance.

The Marin County Green Building Requirements define which projects shall be deemed to be "Covered Projects" within the meaning of this Chapter, and establishing "Compliance Thresholds" applicable to Covered Projects.

A. All Covered Projects shall comply with the Standards for Compliance which shall include, but not be limited to, the following:
   (1) The types and sizes of projects subject to regulation (Covered Projects);
   (2) The green building rating system(s) applicable to various types of Covered Projects;
   (3) Minimum compliance thresholds for various types of Covered Projects; and
   (4) The methods for verification of compliance with these regulations.
B. Cumulative new construction or remodels over any one-year period shall be considered as a single Covered Project, and subject to the highest compliance threshold based on the cumulative project size or valuation.
C. The Chief Building Official shall determine the appropriate project valuation based on the cost of similar improvements, and may request substantiating documentation from the applicant. Where Compliance Thresholds contain project size ranges expressed as both building square footage and project valuation, the intent is to base project requirements upon the project valuation range. However the Chief Building Official shall have the authority to determine whether the building square footage or valuation range most accurately reflects the scope of the proposed project for purposes of determining the required minimum Compliance Threshold.
D. The Chief Building Official may determine that an alternative green building rating system may be used to determine project compliance, where it can be demonstrated that the alternative rating system is as stringent as or greater in terms of reduced energy and resource use and improved interior air quality than that normally required by the Standards for Compliance.

E. Mixed use (residential and commercial) projects must comply either with the applicable Covered Project requirements for the respective residential and commercial portions of the project, or may propose to utilize a mixed use rating system, subject to approval by the Chief Building Official.
F. The cost of reviewing any proposals requesting the use of alternate green building rating systems or requests for exemptions including, but not limited to, the cost of the County of hiring a consultant to review the proposal, shall be borne by the applicant.
G. All buildings submitted for permit must meet all applicable requirements of the 2008 Building Energy Efficiency Standards, California Code of Regulations, Title 24, Part 6, or subsequently adopted state energy standards.
H. The applicable green building rating system shall be that which is most recently adopted by Build It Green or the U.S. Green Building Council. The green building rating system in effect at the time of building permit submittal shall be that which is applicable to the development project throughout the project construction.

19.04.150 Incentives for Compliance.

In addition to the required standards for compliance, the Board of Supervisors may establish by resolution financial or application processing incentives and/or award or recognition programs to encourage higher levels of green building compliance for a project.

19.04.160 Administrative Procedures.

The procedures for compliance with the provisions of this Chapter shall include, but not be limited to, the following:

A. Project design: Applicants for a Covered Project are strongly encouraged to involve a qualified green building rater in the initial design phases of the project in advance of submittal of an application to determine applicable green building compliance thresholds and the most cost effective and appropriate means of achieving compliance.
B. Planning applications: If a discretionary planning application is required for a Covered Project, applicants should be prepared to identify expected green building measures to be included in the project to achieve the compliance thresholds. Applicants should identify any anticipated difficulties in achieving compliance and any exemptions from the requirements of this Chapter that may be requested.
C. Building plan check review: Upon submittal of an application for a building permit, building plans for any Covered Project shall include a green building program description and completed checklist. The checklist shall be incorporated onto a separate full-sized plan sheet included with the building plans. A qualified green building rater shall provide evidence that the project, as indicated by the project plans and green building program description, will achieve the Standards for Compliance outlined in Section 19.04.140 prior to issuance of a building permit.
D. Changes during construction: During the construction process, alternate green building measures may be substituted, provided that the qualified green building rater provides documentation of the proposed change and the project's continued ability to achieve the Standards for Compliance to the Chief Building Official.
E. Final building inspection: Prior to final building inspection and occupancy for any Covered Project, a qualified green building rater shall provide evidence that project construction has achieved the required compliance set forth in the Standards for Compliance outlined in Section 19.04.140. The Chief Building Official shall review the documentation submitted by the applicant, and determine whether the project has achieved the

compliance threshold as set forth in the Standards for Compliance outlined in Section 19.04.140. Where subsequent certification of the building is required by the Standards for Compliance, the Chief Building Official shall also determine whether the applicant has demonstrated that such certification is in process and will be achieved not later than one year after approval of final building inspection. If the Chief Building Official determines that the applicant has met these requirements, the final building inspection may proceed.

F. Post final inspection requirement: Where certification of the building is required by the Standards for Compliance, and such certification is only available subsequent to occupancy of the completed building, the applicant shall provide documentation of such certification within one year of the date of the final building inspection for the project. Failure to provide evidence of this certification within this timeframe, or within an alternate timeframe as determined by the Chief Building Official, will result in a determination that the Covered Project is not in compliance with the requirements of this Chapter.

G. Conflict with other laws: The provisions of this Chapter are intended to be in addition to and not in conflict with other laws, regulations and ordinances relating to building construction and site development. If any provision of this Chapter conflicts with any duly adopted and valid statutes or regulations of the federal government of the State of California, the federal or state statutes or regulations shall take precedence.

19.04.170 Exemptions.

A. The provisions of this Chapter shall not apply to:
   (1) Buildings which are temporary (such as construction trailers).
   (2) Building area which is not or is not intended to be conditioned space.
   (3) Any requirements of this Chapter which would impair the historic integrity of any building listed on a local, state or federal register of historic structures, as determined by the Chief Building Official. In making such a determination, the Chief Building Official may require the submittal of an evaluation by an architectural historian or similar expert.

B. Hardship or Infeasibility Exemption: If an applicant for a Covered Project believes that circumstances exist that make it a hardship or infeasible to meet the requirements of this Chapter, the applicant may request an exemption as set forth below. In applying for an exemption, the burden is on the applicant to show hardship or infeasibility.
   (1) Application: The applicant shall identify in writing the specific requirements of the Standards for Compliance that the project is unable to achieve and the circumstances that make it a hardship or infeasible for the project to comply with this Chapter. Circumstances that constitute hardship or infeasibility shall include, but are not limited to, the following:
      i. There is a conflict between the provisions of the applicable green building rating system and the California Building Standards Code, other State code provisions, other requirements of this Title or conditions imposed on the project through a previously approved planning application;
      ii. There is a lack of commercially available green building materials and technologies to comply with the green building rating system;
      iii. That the cost of achieving compliance is disproportionate to the overall cost of the project;
      iv. That physical conditions of the project site make it impractical to incorporate necessary green building measures or achieve the Standards for Compliance;

v. That compliance with certain requirements would impair the historic integrity of buildings listed on a local, state or federal list or register of historic structures;

(2) Granting of exemption: If the Chief Building Official determines that it is a hardship or infeasible for the applicant to fully meet the requirements of this Chapter, the Chief Building Official shall determine the maximum feasible threshold of compliance reasonably achievable for the project. In making this determination, the Chief Building Official shall consider whether alternate, practical means of achieving the objectives of this Chapter can be satisfied, such as reducing comparable energy use at an offsite location within the County. If an exemption is granted, the applicant shall be required to comply with this chapter in all other respects and shall be required to achieve the threshold of compliance determined to be achievable by the Chief Building Official.

(3) Denial of exception: If the Chief Building Official determines that it is reasonably possible for the applicant to fully meet the requirements of this Chapter, the request shall be denied and the applicant shall be notified of the decision in writing. The project and compliance documentation shall be modified to comply with the Standards for Compliance.

Appeal: Any aggrieved applicant or person may appeal the determination of the Chief Building Official regarding the granting or denial of an exemption or compliance with any other provision of this Chapter. An appeal of a determination of the Chief Building Official shall be filed in writing and processed in accordance with the provisions of Chapter 22.114 of the Marin County Code.

TABLE A: GREEN BUILDING STANDARDS FOR COMPLIANCE FOR RESIDENTIAL CONSTRUCTION AND RENOVATION

Covered Project	Green Building Rating System	Minimum Compliance Threshold	Energy Budget Below CA Title 24 Part 6	Verification
Single-Family or Two-Family Residential: New construction				
500-2,499 sq. ft. (per unit)	GPR New Home	75 points	15%	Green Point Rated[1]
2,500-3,999 sq. ft. (per unit)	GPR New Home	100 points	15%	Green Point Rated[1]
4,000-5,499 sq. ft. (per unit)	GPR New Home	125 points	20%	Green Point Rated[1]
5,500-6,999 sq. ft. (per unit)	GPR New Home	150 points	30%	Green Point Rated[1]
7,000+ sq. ft. (per unit)	GPR New Home	200 points	Net zero energy	Green Point Rated[1]
Single-Family or Two-Family Residential: Renovations (including additions to existing buildings)				
Less than $50,000 valuation	n/a	Insulate exposed hot water pipes; Install radiant barrier when reroofing and removing sheathing		City building inspector
$50,000-$99,999 valuation or less than 500 sq. ft.[3]	GPR Existing Home	Checklist submittal and completion of a HERSII or BPI home performance audit		City plan check
$100,000-$149,999 valuation or 500-749 sq. ft.[3]	GPR Existing Home – Elements	25 points		GreenPoint Rater[2]
$150,000-$299,999 valuation or 750-999 sq. ft.[3]	GPR Existing Home – Elements	35 points		GreenPoint Rater[2]
$300,000+ valuation or 1,000+ sq. ft.[3]	GPR Existing Home – Whole House	50 points + 20% improvement in HERSII or BPI home performance audit results or a minimum HERSII score of 100		GreenPoint Rated[2]
Multi-Family Residential: New Construction				
Less than 1,000 sq. ft. average unit size	GPR Multi-Family	60 points	15%	GreenPoint Rated[1]
1,000+ sq. ft. average unit size	GPR Multi-Family	75 points	15%	GreenPoint Rated[1]

[1] Project verification by GreenPoint Rater and certification by Build It Green

[2] Project verification by GreenPoint Rater

[3] Project valuation will be the primary determinate in establishing the Minimum Compliance Threshold for the project, with use of project size range when valuation is uncertain or in the opinion of the building official does not accurately reflect the project scope.

TABLE B: GREEN BUILDING STANDARDS FOR COMPLIANCE FOR NONRESIDENTIAL CONSTRUCTION AND RENOVATION

Covered Project	Green Building Rating System	Minimum Compliance Threshold	Energy Budget Below CA Title 24 Part 6	Verification
New construction (including additions to existing buildings)				
2,000-4,999 sq. ft.	LEED® New Construction or Core & Shell	Checklist submittal + compliance with Prerequisites		LEED® AP with additional GreenPoint Rater or BPI Certification
5,000-49,999 sq. ft.	LEED® New Construction or Core & Shell	LEED® Silver	15%	LEED® AP with additional GreenPoint Rater or BPI Certification
50,000+ sq. ft.	LEED® New Construction or Core & Shell	LEED® Gold	15%	GBCI Certified
Renovations				
Less than $500,000 valuation or 500-4,999 sq. ft. [3]	LEED® Commercial Interiors or Operations & Maintenance	**Voluntary** compliance with the following Prerequisites: WE P1 (Water Efficiency–Baseline Requirements only)[4] EA P3 (Fundamental Refrigerant Management) for renovations of ≥50% of the building interior area **Voluntary** compliance with the following Credits: EA C1.3 (Optimize Energy Performance – HVAC) for renovations of ≥50% of the building interior area		None
$500,000 - $5 million valuation or 5,000-24,999 sq. ft. [3]	LEED® Commercial Interiors or Operations & Maintenance	Same as above, but Required.		City building inspector
Greater than $5 million valuation or 25,000+ sq. ft. [3]	LEED® Commercial Interiors or Operations & Maintenance	LEED® Silver		LEED® AP with additional GreenPoint Rater or BPI Certification

[3] Project valuation will be the primary determinate in establishing the Minimum Compliance Threshold for the project, with use of project size range when valuation is uncertain or in the opinion of the building official does not accurately reflect the project scope.

[4] Applicable only to fixtures within area of renovation or restrooms associated with area of renovation.

SOLAR ELECTRIC SYSTEMS

A solar photovoltaic (PV) energy system may be used to meet the Energy Budget Below CA Title 24 Part 6 requirements of this resolution which exceed 15%. To qualify for energy credits, the PV energy system must be capable of generating electricity from sunlight, supply the electricity directly to the building, and the system is connected, through a reversible meter, to the utility grid. The installation of any qualifying PV energy system must meet all installation criteria contained in the California Energy Commission's Guidebook "Eligibility Criteria and Conditions for Incentives for Solar Energy Systems." The methodology used to calculate the energy equivalent to the PV credit shall be the CECPV Calculator, using the most recent version, provided by the California Energy Commission.

INCENTIVES

A City Green Building emblem for construction signage shall be provided for all residential and non-residential projects that obtain a GreenPoint or LEED rating.

The following incentives shall be provided for residential projects that achieve at least 100 GreenPoints or non-residential projects that achieve at least a LEED® Gold rating:

1. Expedited building permit plan check (typically 2-week turnaround)
2. Reimbursement for the cost of the GreenPoint Rater services (residential projects only, up to a maximum of $1,000)
3. Provision of a bronze plaque for building mounting, identifying the project as a green building

EXCEPTIONS

The following shall not be included as Covered Projects:

1. Buildings which are temporary,
2. Building area which is not or is not intended to be conditioned space, and
3. Any requirement which would impair the historic integrity of any building listed on a local, state or federal register of historic structures.

The following shall not be included in project valuation:

1. Improvements primarily intended for seismic upgrades or required disabled access,
2. Building replacement due to catastrophic loss due to flood or earthquake damage, and
3. Installation of renewable energy systems.

Appendix:

Marin County Energy Cost-Effectiveness Study

December 10, 2009

Codes and Standards
Title 24 Energy-Efficient Local Ordinances

Title:
Marin County Green Building Ordinance
Energy Cost-Effectiveness Study

Prepared for:

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City of San Rafael
Community Development Director

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Prepared by:

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Last Modified: December 10, 2009

Marin County Green Building Ordinance
Energy Cost-Effectiveness Study

December 10, 2009

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LEGAL NOTICE

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Table of Contents

1.0 Executive Summary

This report presents the results of Gabel Associates' research and review of the feasibility and energy cost-effectiveness of building permit applicants exceeding the 2008 Building Energy Efficiency Standards to meet the minimum energy-efficiency requirements of the proposed Marin County Ordinance for local energy efficiency standards. The proposed ordinance states that residential new construction projects must meet the overall requirements summarized in the Resolution printed on the following pages.

The study contained in this report shall be included in Marin County's application to the California Energy Commission (CEC) which must meet the requirements specified in Section 10-106 of the California Code of Regulations, Title 24, Part 1, LOCALLY ADOPTED ENERGY STANDARDS. The proposed Ordinance shall be enforceable after the CEC has reviewed and approved the local energy standards as meeting all requirements of Section 10-106; and the Ordinance has been adopted by the County and filed with the Building Standards Commission.

The 2008 Building Energy Efficiency Standards, scheduled to take effect on January 1, 2010, are the baseline used to calculate the cost-effectiveness of the proposed Ordinance.

MARIN COUNTY MODEL GREEN BUILDING ORDINANCE (Draft)

TABLE A: GREEN BUILDING STANDARDS FOR COMPLIANCE FOR RESIDENTIAL CONSTRUCTION AND RENOVATION

Covered Project	Green Building Rating System	Minimum Compliance Threshold	Energy Budget Below CA Title 24 Part 6	Verification
Single-Family or Two-Family Residential: New construction				
500-2,499 sq. ft.	GPR New Home	75 points	15%	Green Point Rated[1]
2,500-3,999 sq. ft.	GPR New Home	100 points	15%	Green Point Rated[1]
4,000-5,499 sq. ft.	GPR New Home	125 points	20%	Green Point Rated[1]
5,500-6,999 sq. ft.	GPR New Home	150 points	30%	Green Point Rated[1]
7,000+ sq. ft.	GPR New Home	200 points	Net zero energy	Green Point Rated[1]
Single-Family or Two-Family Residential: Renovations (including additions to existing buildings)				
Less than $50,000 valuation	n/a	Insulate exposed hot water pipes; Install radiant barrier when reroofing and removing sheathing		City building inspector
Less than 500 sq. ft. or $50,000-$99,999 valuation[3]	GPR Existing Home	Checklist submittal and completion of a HERSII or BPI home performance audit		City plan check
500-749 sq. ft. or $100,000-$149,999 valuation[3]	GPR Existing Home – Elements	25 points		GreenPoint Rater[2]
750-999 sq. ft. or $150,000-$299,999 valuation[3]	GPR Existing Home – Elements	35 points		GreenPoint Rater[2]
1,000+ sq. ft. or $300,000+ valuation[3]	GPR Existing Home – Whole House	50 points + 20% improvement in HERSII or BPI home performance audit results or a HERSII score 100 or better		GreenPoint Rated[2]
Multi-Family Residential: New Construction				
Less than 1,000 sq. ft. average unit size	GPR Multi-Family	60 points	15%	GreenPoint Rated[1]
1,000+ sq. ft. average unit size	GPR Multi-Family	75 points	15%	GreenPoint Rated[1]

[1] Project verification by GreenPoint Rater and certification by Build It Green

[2] Project verification by GreenPoint Rater

[3] Project valuation will be the primary determinate in establishing the Minimum Compliance Threshold for the project, with use of project size range when valuation is uncertain or in the opinion of the building official does not accurately reflect the project scope.

MARIN COUNTY MODEL GREEN BUILDING ORDINANCE (Draft)

TABLE B: GREEN BUILDING STANDARDS FOR COMPLIANCE FOR NONRESIDENTIAL CONSTRUCTION AND RENOVATION

Covered Project	Green Building Rating System	Minimum Compliance Threshold	Energy Budget Below CA Title 24 Part 6	Verification
New construction (including additions to existing buildings)				
2,000-4,999 sq. ft.	LEED® New Construction or Core & Shell	Checklist submittal + compliance with Prerequisites		LEED® AP with additional GreenPoint Rater or BPI Certification
5,000-49,999 sq. ft.	LEED® New Construction or Core & Shell	LEED® Silver	15%	LEED® AP with additional GreenPoint Rater or BPI Certification
50,000+ sq. ft.	LEED® New Construction or Core & Shell	LEED® Gold	15%	GBCI Certified
Renovations				
500-4,999 sq. ft. or less than $500,000 valuation[3]	LEED® Commercial Interiors or Operations & Maintenance	**Voluntary** compliance with the following Prerequisites: WE P1 (Water Efficiency – Baseline Requirements only) EA P3 (Fundamental Refrigerant Management) for renovations of ≥50% of the building interior area **Voluntary** compliance with the following Credits: EA C1.3 (Optimize Energy Performance – HVAC) for renovations of ≥50% of the building interior area		None
5,000-24,999 sq. ft. or $500,000 - $5 million valuation[3]	LEED® Commercial Interiors or Operations & Maintenance	Same as above, but Required.		City building inspector
25,000+ sq. ft. or greater than $5 million valuation[3]	LEED® Commercial Interiors or Operations & Maintenance	LEED® Silver		LEED® AP with additional GreenPoint Rater or BPI Certification

[3] Project valuation will be the primary determinate in establishing the Minimum Compliance Threshold for the project, with use of project size range when valuation is uncertain or in the opinion of the building official does not accurately reflect the project scope.

SOLAR ELECTRIC SYSTEMS

A solar photovoltaic (PV) energy system may be used to meet the Energy Budget Below CA Title 24 Part 6 requirements of this resolution which exceed 15%. To qualify for energy credits, the PV energy system must be capable of generating electricity from sunlight, supply the electricity directly to the building, and the system is connected, through a reversible meter, to the utility grid. The installation of any qualifying PV energy system must meet all installation criteria contained in the California Energy Commission's Guidebook "Eligibility Criteria and Conditions for Incentives for Solar Energy Systems." The methodology used to calculate the energy equivalent to the PV credit shall be the CECPV Calculator, using the most recent version, provided by the California Energy Commission.

INCENTIVES [optional]

A City Green Building emblem for construction signage shall be provided for all residential and non-residential projects that obtain a GreenPoint or LEED rating.

The following incentives shall be provided for residential projects that achieve at least 100 GreenPoints or non-residential projects that achieve at least a LEED® Gold rating:

1. Expedited building permit plan check (typically 2-week turnaround)
2. Reimbursement for the cost of the GreenPoint Rater services (residential projects only, up to a maximum of $1,000)
3. Provision of a bronze plaque for building mounting, identifying the project as a green building

EXCEPTIONS [optional]

The following shall not be included as Covered Projects:

1. Second dwelling units,
2. Buildings which are temporary,
3. Building area which is not or is not intended to be conditioned space, and
4. Any requirement which would impair the historic integrity of any building listed on a local, state or federal register of historic structures.

The following shall not be included in project valuation:

1. Improvements primarily intended for seismic upgrades or required disabled access,
2. Building replacement due to catastrophic loss due to flood or earthquake damage, and
3. Installation of renewable energy systems.

2.0 Impacts of the New Ordinance

The energy performance impacts of the Ordinance have been evaluated using several prototypical designs which collectively reflect a broad range of building types, including:

- Single family house: 2-story 1,582 sf (CZ3)
- Single family house: 2-story 2,025 sf (CZ2, CZ3)
- Single family house: 2-story 2,682 sf (CZ2)
- Single family house: 2-story 5,000 sf (CZ2, CZ3): Exceeding Title 24 by 20%
- Single family house: 2-story 6,500 sf (CZ2, CZ3): Exceeding Title 24 by 30%
- Single family house: 2-story 7,500 sf (CZ2, CZ3): Net Energy Zero TDV
- Low-rise Multi-family building, 8 dwelling units: 2-story 8,442 sf (CZ2, CZ3)
- High-rise Multi-family building, 40 dwelling units: 4-story 36,800 sf (CZ2, CZ3)
- Nonresidential office building: 2-story, 21,160 sf (CZ2, CZ3)
- Nonresidential office building: 5-story, 52,900 sf (CZ2, CZ3)

The methodology used in the case studies is based on a design process for buildings that meet or exceed the energy standards, and includes the following:

(a) Each prototype building design is tested for compliance with the 2008 Standards, and the mix of energy measures are adjusted using common construction options so the building first just meets the Standards. The set of energy measures chosen represent a reasonable combination which reflects how designers, builders and developers are likely to achieve a specified level of performance using a relatively low first incremental (additional) cost

(b) Starting with that set of measures which is minimally compliant with the 2008 Standards, various energy measures are upgraded so that the building just meets the minimum energy performance required by the proposed Ordinance (e.g., 15% better than 2008 Title 24). The design choices by the consultant authoring this study are based on many years of experience with architects, builders, mechanical engineers; and general knowledge of the relative acceptance and preferences of many measures, as well as their incremental costs. This approach tends to reflect how building energy performance is typically evaluated for code compliance and how it's used to select design energy efficiency measures. Note that lowest simple payback with respect to building site energy is not always the primary focus of selecting measures; but rather the requisite reduction of Title 24 Time Dependent Valuation(TDV) energy at a reasonably low incremental cost consistent with other non-monetary but important design considerations.

(c) A minimum and maximum range of incremental costs of added energy efficiency measures is established by a variety of research means. A construction cost estimator, Building Advisory LLC, was contracted to conduct research to obtain current measure cost information for many energy measures; and Gabel Associates performed its own additional research to establish first cost data. Site energy in kWh and therms, is calculated from the Title 24 simulation results to establish the annual energy savings, energy cost savings and CO2-equivalent reductions in greenhouse gases.

2.1 Single Family Homes

CLIMATE ZONE 2

The following energy design descriptions of single family building prototypes just meet the 2008 Title 24 Building Energy Efficiency Standards in **Climate Zone 2:**

CZ2: Single Family House 2,025 square feet, 2-story, 20.2% glazing/floor area ratio

Energy Efficiency Measures
R-38 Roof w/ Radiant Barrier
R-13 Walls
R-0 Slab on Grade
R-19 Raised Floor over Garage/Open at 2nd Floor
Low E2 Vinyl Windows, U=0.36, SHGC=0.30
Furnace: 80% AFUE
Air Conditioner: 13 SEER
R-6 Attic Ducts
Reduced Duct Leakage/Testing (HERS)
50 Gallon Gas Water Heater: EF=0.60

CZ2: Single Family House 2,682 square feet, 2-story, 21.1% glazing/floor area ratio

Energy Efficiency Measures
R-30 Roof w/ Radiant Barrier
R-13 Walls
R-19 Raised Floor
Low E2 Vinyl Windows, U=0.36, SHGC=0.30
Furnace: 80% AFUE
Air Conditioner: 13 SEER
R-6 Attic Ducts
Reduced Duct Leakage/Testing (HERS)
50 Gallon Gas Water Heaters: EF=0.60

CZ2: Single Family House 5,000 square feet, 2-story, 22.0% glazing/floor area ratio

Energy Efficiency Measures
R-38 Roof w/ Radiant Barrier
R-13 Walls
R-19 Raised Floor
Low E2 Vinyl Windows, U=0.36, SHGC=0.30
(2) Furnaces: 80% AFUE
(2) Air Conditioners: 13 SEER, 11 EER (HERS)
(2) Air Conditioners: Refrig. Charge (HERS)
R-8 Attic Ducts
Reduced Duct Leakage/Testing (HERS)
(2) 50 Gallon Gas Water Heaters: EF=0.60

CZ2: Single Family House 6,500 square feet, 2-story, 22.0% glazing/floor area ratio

Energy Efficiency Measures
R-30 Roof w/ Radiant Barrier
R-13 Walls
R-19 Raised Floor
Quality Insulation Installation (HERS)
Low E2 Vinyl Windows, U=0.36, SHGC=0.30
(3) Furnaces: 80% AFUE
(3) Air Conditioners: 13 SEER, 11 EER (HERS)
(3) Air Conditioners: Refrig. Charge (HERS)
R-8 Attic Ducts
Reduced Duct Leakage/Testing (HERS)
(3) 50 Gallon Gas Water Heaters: EF=0.60

CZ2: Single Family House 7,500 square feet, 2-story, 22.0% glazing/floor area ratio

Energy Efficiency Measures
R-30 Roof w/ Radiant Barrier
R-13 Walls
R-19 Raised Floor
Quality Insulation Installation (HERS)
Low E2 Vinyl Windows, U=0.36, SHGC=0.30
(3) Furnaces: 80% AFUE
(3) Air Conditioners: 13 SEER, 11 EER (HERS)
(3) Air Conditioners: Refrig. Charge (HERS)
R-8 Attic Ducts
Reduced Duct Leakage/Testing (HERS)
(3) 50 Gallon Gas Water Heaters: EF=0.60

Climate Zone 2 Energy Efficiency Measures Needed to Meet the Ordinance

The following tables list the energy features and/or equipment included in the Title 24 base design, the efficient measure options, and an estimate of the incremental cost for each measure included **to improve the building performance to use 15% less TDV energy than the corresponding Title 24 base case design** (except homes equal or greater than 4,000 square feet as indicated).

In any actual project, the designer, builder or owner selects which measures will be included to meet the proposed Ordinance requirements. There are a number of factors in choosing the final mix of energy measures including first cost, aesthetics, maintenance and replacement considerations. The analysis includes at least two different options to meet the proposed Ordinance requirements for each prototypical design.

Incremental Cost Estimate to Exceed Title 24 by 15%
Single Family Prototype: 2,025 SF, Option 1 **2025 sf** **Climate Zone 2**

Energy Efficiency Measures	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-38 Roof w/ Radiant Barrier	-	$ -	$ -	$ -
R-19 Walls (from R-13): 2,550 sf @ $0.55 to $0.85/sf	Upgrade	$ 1,403	$ 2,168	$ 1,786
R-0 Slab on Grade	-	$ -	$ -	$ -
R-19 Raised Floor over Garage/Open at 2nd Floor	-	$ -	$ -	$ -
Low E2 Vinyl Windows, U=0.36, SHGC=0.30	-	$ -	$ -	$ -
Furnace: 80% AFUE	-	$ -	$ -	$ -
Air Conditioner: 13 SEER, 11 EER (HERS)	Upgrade	$ 25	$ 75	$ 50
Air Conditioner: Refrig. Charge (HERS)	Upgrade	$ 150	$ 200	$ 175
R-6 Attic Ducts	-	$ -	$ -	$ -
Reduced Duct Leakage/Testing (HERS)	-	$ -	$ -	$ -
50 Gallon Gas Water Heater: EF=0.60	-	$ -	$ -	$ -
Total Incremental Cost of Energy Efficiency Measures:		**$ 1,578**	**$ 2,443**	**$ 2,011**
Total Incremental Cost per Square Foot:		**$ 0.78**	**$ 1.21**	**$ 0.99**

Incremental Cost Estimate to Exceed Title 24 by 15%

Single Family Prototype: 2,025 SF, Option 2 **2025 sf** **Climate Zone 2**

Energy Efficiency Measures	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-38 Roof w/ Radiant Barrier	-	$ -	$ -	$ -
R-21 Walls (from R-13): 2,550 sf @ $0.70 to $0.95/sf	Upgrade	$ 1,785	$ 2,423	$ 2,104
R-0 Slab on Grade	-	$ -	$ -	$ -
R-19 Raised Floor over Garage/Open at 2nd Floor	-	$ -	$ -	$ -
Low E2 Vinyl Windows, U=0.36, SHGC=0.30	-	$ -	$ -	$ -
Furnace: 80% AFUE	-	$ -	$ -	$ -
Air Conditioning: 13 SEER	-	$ -	$ -	$ -
R-6 Attic Ducts	-	$ -	$ -	$ -
Reduced Duct Leakage/Testing (HERS)	-	$ -	$ -	$ -
50 Gallon Gas Water Heater: EF=0.60	-	$ -	$ -	$ -
Total Incremental Cost of Energy Efficiency Measures:		**$ 1,785**	**$ 2,423**	**$ 2,104**
Total Incremental Cost per Square Foot:		**$ 0.88**	**$ 1.20**	**$ 1.04**

Incremental Cost Estimate to Exceed Title 24 by 15%

Single Family Prototype: 2,682 SF, Option 1 **2682 sf** **Climate Zone 2**

Energy Efficiency Measures	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-30 Roof w/ Radiant Barrier	-	$ -	$ -	$ -
R-19 Walls (from R-13): 2,638 sf @ $0.55 to $0.85/sf	Upgrade	$ 1,451	$ 2,242	$ 1,847
R-19 Floor	-	$ -	$ -	$ -
Low E2 Vinyl Windows, U=0.36, SHGC=0.30	-	$ -	$ -	$ -
Furnace: 80% AFUE	-	$ -	$ -	$ -
Air Conditioner: 13 SEER, 11 EER (HERS)	Upgrade	$ 25	$ 75	$ 50
Air Conditioner: Refrig. Charge (HERS)	Upgrade	$ 150	$ 200	$ 175
R-6 Attic Ducts	-	$ -	$ -	$ -
Reduced Duct Leakage/Testing (HERS)	-	$ -	$ -	$ -
50 Gallon Gas Water Heater: EF=0.60	-	$ -	$ -	$ -
Total Incremental Cost of Energy Efficiency Measures:		**$ 1,626**	**$ 2,517**	**$ 2,072**
Total Incremental Cost per Square Foot:		**$ 0.61**	**$ 0.94**	**$ 0.77**

Incremental Cost Estimate to Exceed Title 24 by 15%
Single Family Prototype: 2,682 SF, Option 2 **2682 sf** **Climate Zone 2**

Energy Efficiency Measures	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-38 Roof w/ Radiant Barrier (from R-30): 1,402sf @ 0.40 to 0.60/sf	Upgrade	$ 561	$ 841	$ 701
R-15 Walls (from R-13): 2,638 sf @ $0.12 to $0.20/sf	Upgrade	$ 317	$ 528	$ 422
R-19 Floor	-	$ -	$ -	$ -
Quality Insulation Installation (HERS)	Upgrade	$ 450	$ 600	$ 525
Low E2 Vinyl Windows, U=0.36, SHGC=0.30	-	$ -	$ -	$ -
Furnace: 90% AFUE (from 80% AFUE)	Upgrade	$ 500	$ 1,000	$ 750
Air Conditioner: 13 SEER	-	$ -	$ -	$ -
R-6 Attic Ducts	-	$ -	$ -	$ -
Reduced Duct Leakage/Testing (HERS)	-	$ -	$ -	$ -
50 Gallon Gas Water Heater: EF=0.62 (from EF=0.60)	Upgrade	$ 100	$ 200	$ 150
Total Incremental Cost of Energy Efficiency Measures:		**$ 1,928**	**$ 3,169**	**$ 2,548**
Total Incremental Cost per Square Foot:		**$ 0.72**	**$ 1.18**	**$ 0.95**

Incremental Cost Estimate to Exceed Title 24 by 15%
Single Family Prototype: 2,682 SF, Option 3 **2682 sf** **Climate Zone 2**

Energy Efficiency Measures	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-30 Roof w/ Radiant Barrier	-	$ -	$ -	$ -
R-21 Walls (from R-13): 2,638 sf @ $0.70 to $0.95/sf	Upgrade	$ 1,847	$ 2,506	$ 2,177
R-19 Floor	-	$ -	$ -	$ -
Low E2 Vinyl Windows, U=0.36, SHGC=0.30	-	$ -	$ -	$ -
Furnace: 80% AFUE	-	$ -	$ -	$ -
Air Conditioner: 13 SEER	-	$ -	$ -	$ -
R-6 Attic Ducts	-	$ -	$ -	$ -
Reduced Duct Leakage/Testing (HERS)	-	$ -	$ -	$ -
50 Gallon Gas Water Heater: EF=0.62 (from EF=0.60)	Upgrade	$ 100	$ 200	$ 150
Total Incremental Cost of Energy Efficiency Measures:		**$ 1,947**	**$ 2,706**	**$ 2,327**
Total Incremental Cost per Square Foot:		**$ 0.73**	**$ 1.01**	**$ 0.87**

For homes ≥ 4,000 square feet to 5,499 square feet, the following tables list the energy measures needed to improve a 5,000 square foot home so that it uses at least 20% less TDV energy than the corresponding Title 24 base case design.

Incremental Cost Estimate to Exceed Title 24 by 20%
Single Family Prototype: 5,000 SF, Option 1 **5000 sf** **Climate Zone 2**

Energy Efficiency Measures	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-38 Roof w/ Radiant Barrier	-	$ -	$ -	$ -
R-21 Walls (from R-13): 2,616 sf @ $0.45 to $0.70/sf	Upgrade	$ 1,177	$ 1,831	$ 1,504
R-19 Raised Floor	-	$ -	$ -	$ -
Super Low E Vinyl Windows, U=0.36, SHGC=0.23 (from Low E2, U=0.36, SHGC=0.23): 1,100 sf @ $1.40 - $1.75 / sf	Upgrade	$ 1,540	$ 1,925	$ 1,733
(2) Furnace: 92% AFUE (from 80% AFUE)	Upgrade	$ 1,000	$ 2,400	$ 1,700
(2) Air Conditioners: 13 SEER, 11 EER (HERS)	-	$ -	$ -	$ -
(2) Air Conditioner: Refrig. Charge (HERS)	-	$ -	$ -	$ -
R-8 Attic Ducts	-	$ -	$ -	$ -
Reduced Duct Leakage/Testing (HERS)	-	$ -	$ -	$ -
(2) 50 Gallon Gas Water Heaters: EF=0.62 (from EF=0.60)	Upgrade	$ 200	$ 400	$ 300
Total Incremental Cost of Energy Efficiency Measures:		**$ 3,917**	**$ 6,556**	**$ 5,237**
Total Incremental Cost per Square Foot:		**$ 0.78**	**$ 1.31**	**$ 1.05**

Incremental Cost Estimate to Exceed Title 24 by 20%
Single Family Prototype: 5,000 SF, Option 2 **5000 sf** **Climate Zone 2**

Energy Efficiency Measures	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-38 Roof w/ Radiant Barrier	-	$ -	$ -	$ -
R-21 Walls (from R-13): 2,616 sf @ $0.45 to $0.70/sf	Upgrade	$ 1,177	$ 1,831	$ 1,504
R-38 Raised Floor (from R-19): 3,000 sf @ $0.30 to $0.45	Upgrade	$ 900	$ 1,350	$ 1,125
Quality Insulation Installation (HERS)	Upgrade	$ 450	$ 600	$ 525
Super Low E Vinyl Windows, U=0.36, SHGC=0.23 (from Low E2, U=0.36, SHGC=0.23): 1,100 sf @ $1.40 - $1.75 / sf	Upgrade	$ 1,540	$ 1,925	$ 1,733
(2) Furnaces: 80% AFUE	-	$ -	$ -	$ -
(2) Air Conditioners: 13 SEER, 11 EER (HERS)	-	$ -	$ -	$ -
(2) Air Conditioner: Refrig. Charge (HERS)	-	$ -	$ -	$ -
R-6 Attic Ducts (from R-8)	Downgrade	$ (650)	$ (450)	$ (550)
Reduced Duct Leakage/Testing (HERS)	-	$ -	$ -	$ -
(2) 50 Gallon Gas Water Heaters: EF=0.62 (from EF=0.60)	Upgrade	$ 200	$ 400	$ 300
Total Incremental Cost of Energy Efficiency Measures:		**$ 3,617**	**$ 5,656**	**$ 4,637**
Total Incremental Cost per Square Foot:		**$ 0.72**	**$ 1.13**	**$ 0.93**

Incremental Cost Estimate to Exceed Title 24 by 20%
Single Family Prototype: 5,000 SF, Option 3 **5000 sf** **Climate Zone 2**

Energy Efficiency Measures	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-38 Roof w/ Radiant Barrier	-	$ -	$ -	$ -
R-21 Walls (from R-13): 2,616 sf @ $0.45 to $0.70/sf	Upgrade	$ 1,177	$ 1,831	$ 1,504
R-19 Raised Floor	-	$ -	$ -	$ -
Super Low E Vinyl Windows, U=0.36, SHGC=0.23 (from Low E2, U=0.36, SHGC=0.23): 1,100 sf @ $1.40 - $1.75 / sf	Upgrade	$ 1,540	$ 1,925	$ 1,733
(2) Furnace: 80% AFUE	-	$ -	$ -	$ -
(2) Air Conditioners: 13 SEER, 11 EER (HERS)	-	$ -	$ -	$ -
(2) Air Conditioner: Refrig. Charge (HERS)	-	$ -	$ -	$ -
R-6 Attic Ducts (from R-8)	Downgrade	$ (650)	$ (450)	$ (550)
Reduced Duct Leakage/Testing (HERS)	-	$ -	$ -	$ -
(2) Instantaneous Gas Water Heater: RE=0.80 (from (2) 50 Gal Gas: EF=0.62)	Upgrade	$ 1,800	$ 3,000	$ 2,400
Total Incremental Cost of Energy Efficiency Measures:		**$ 3,867**	**$ 6,306**	**$ 5,087**
Total Incremental Cost per Square Foot:		**$ 0.77**	**$ 1.26**	**$ 1.02**

For homes ≥ 5,500 square feet to 6,999 square feet, the following tables list the energy measures needed to improve a 6,500 square foot home so that it uses at least 30% less TDV energy than the corresponding Title 24 base case design.

Incremental Cost Estimate to Exceed Title 24 by 30%
Single Family Prototype: 6,500 SF, Option 1 **6500 sf** **Climate Zone 2**

Energy Efficiency Measures	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-38 Roof w/ Radiant Barrier (from R-30 w/Radiant Barrier): 3,900 sf @ 0.15 to 0.20/sf	Upgrade	$ 585	$ 780	$ 683
R-21 Walls (from R-13): 2,808 sf @ $0.45 to $0.70/sf	Upgrade	$ 1,264	$ 1,966	$ 1,615
R-30 Raised Floor (from R-19): 3,900 sf @ $0.25 to $0.35	Upgrade	$ 975	$ 1,365	$ 1,170
Quality Insulation Installation (HERS)	-	$ -	$ -	$ -
Super Low E Vinyl Windows, U=0.36, SHGC=0.23 (from Low E2, U=0.36, SHGC=0.23): 1,430 sf @ $1.40 - $1.75 / sf	Upgrade	$ 2,002	$ 2,503	$ 2,252
(3) Furnaces: 92% AFUE (from 80% AFUE)	Upgrade	$ 1,500	$ 3,600	$ 2,550
(3) Air Conditioners: 13 SEER, 11 EER (HERS)	-	$ -	$ -	$ -
(3) Air Conditioner: Refrig. Charge (HERS)	-	$ -	$ -	$ -
R-6 Attic Ducts (from R-8)	Downgrade	$ (975)	$ (675)	$ (825)
Reduced Duct Leakage/Testing (HERS)	-	$ -	$ -	$ -
(3) Instantaneous Gas Water Heater: RE=0.80 (from (3) 50 Gal Gas: EF=0.60)	Upgrade	$ 3,000	$ 5,100	$ 4,050
Pipe Insulation	Upgrade	$ 450	$ 600	$ 525
Total Incremental Cost of Energy Efficiency Measures:		**$ 8,801**	**$ 15,238**	**$ 12,019**
Total Incremental Cost per Square Foot:		**$ 1.35**	**$ 2.34**	**$ 1.85**

Incremental Cost Estimate to Exceed Title 24 by 30%

Single Family Prototype: 6,500 SF, Option 2 **6500 sf** **Climate Zone 2**

Energy Efficiency Measures	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-38 Roof w/ Radiant Barrier (from R-30 w/Radiant Barrier): 3,900 sf @ 0.15 to 0.20/sf	Upgrade	$ 585	$ 780	$ 683
R-19 Walls (from R-13): 2,808 sf @ $0.31 to $0.54/sf	Upgrade	$ 870	$ 1,516	$ 1,193
R-19 Raised Floor	-	$ -	$ -	$ -
Quality Insulation Installation (HERS)	-	$ -	$ -	$ -
Super Low E Vinyl Windows, U=0.36, SHGC=0.23 (from Low E2, U=0.36, SHGC=0.23): 1,430 sf @ $1.40 - $1.75 / sf	Upgrade	$ 2,002	$ 2,503	$ 2,252
(3) Furnaces: 80% AFUE	-	$ -	$ -	$ -
(3) Air Conditioners: 13 SEER, 11 EER (HERS)	-	$ -	$ -	$ -
(3) Air Conditioner: Refrig. Charge (HERS)	-	$ -	$ -	$ -
R-6 Attic Ducts (from R-8)	Downgrade	$ (975)	$ (675)	$ (825)
Reduced Duct Leakage/Testing (HERS)	-	$ -	$ -	$ -
(3) 50 Gallon Gas Water Heaters: EF=0.62 (from EF=0.60)	Upgrade	$ 300	$ 600	$ 450
Solar Photovoltaic (PV) System: 1 KW	Upgrade	$ 4,500	$ 6,500	$ 5,500
Total Incremental Cost of Energy Efficiency Measures:		**$ 7,282**	**$ 11,224**	**$ 9,253**
Total Incremental Cost per Square Foot:		**$ 1.12**	**$ 1.73**	**$ 1.42**

For homes ≥ 7,000 square feet the following tables list the energy measures needed to improve a 7,500 square foot home so that its net Title 24 TDV energy use is zero (i.e. Net Zero TDV Energy) as compared with the corresponding Title 24 base case design. To achieve this level of performance, a solar PV system is added to the home sized to just meet the Net Zero Energy threshold by rounding up to the next largest whole KW of nominal solar PV capacity.

Incremental Cost Estimate of Net Zero TDV Energy

Single Family Prototype: 7,500 SF, Option 1 **7500 sf** **Climate Zone 2**

Energy Efficiency Measures	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-38 Roof w/ Radiant Barrier (from R-30 w/Radiant Barrier): 4,500 sf @ 0.15 to 0.20/sf	Upgrade	$ 675	$ 900	$ 788
R-21 Walls (from R-13): 2,904 sf @ $0.45 to $0.70/sf	Upgrade	$ 1,307	$ 2,033	$ 1,670
R-38 Raised Floor (from R-19): 4,500 sf @ $0.30 to $0.45	Upgrade	$ 1,350	$ 2,025	$ 1,688
Quality Insulation Installation (HERS)	-	$ -	$ -	$ -
Super Low E Vinyl Windows, U=0.36, SHGC=0.23 (from Low E2, U=0.36, SHGC=0.23): 1,650 sf @ $1.40 - $1.75 / sf	Upgrade	$ 2,310	$ 2,888	$ 2,599
(3) Furnaces: 94% AFUE (from 80% AFUE)	Upgrade	$ 2,700	$ 5,400	$ 4,050
(3) Air Conditioners: 15 SEER, 12 EER (HERS) (from 13 SEER, 11 EER)	Upgrade	$ 1,500	$ 4,500	$ 3,000
(3) Air Conditioners: Refrig. Charge (HERS)	-	$ -	$ -	$ -
R-8 Attic Ducts	-	$ -	$ -	$ -
Reduced Duct Leakage/Testing (HERS)	-	$ -	$ -	$ -
(3) Instantaneous Gas Water Heater: RE=0.82 (from (3) 50 Gal Gas: EF=0.60)	Upgrade	$ 3,600	$ 6,000	$ 4,800
Pipe Insulation	Upgrade	$ 450	$ 600	$ 525
Solar Photovoltaic (PV) System: 4 KW	Upgrade	$ 18,000	$ 26,000	$ 22,000
Total Incremental Cost of Energy Efficiency Measures:		**$ 31,892**	**$ 50,345**	**$ 41,119**
Total Incremental Cost per Square Foot:		**$ 4.25**	**$ 6.71**	**$ 5.48**

Incremental Cost Estimate of Net Zero TDV Energy
Single Family Prototype: 7,500 SF, Option 1 **7500 sf** **Climate Zone 2**

Energy Efficiency Measures	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-38 Roof w/ Radiant Barrier (from R-30 w/Radiant Barrier): 4,500 sf @ 0.15 to 0.20/sf	Upgrade	$ 675	$ 900	$ 788
R-19 Walls (from R-13): 2,904 sf @ $0.31 to $0.54/sf	Upgrade	$ 900	$ 1,568	$ 1,234
R-30 Raised Floor (from R-19): 4,500 sf @ $0.25 to $0.35	Upgrade	$ 1,125	$ 1,575	$ 1,350
Quality Insulation Installation (HERS)	-	$ -	$ -	$ -
Housewrap: 2,904 sf @ $0.50 to $0.75/sf	Upgrade	$ 1,452	$ 2,178	$ 1,815
Super Low E Vinyl Windows, U=0.36, SHGC=0.23 (from Low E2, U=0.36, SHGC=0.23): 1,650 sf @ $1.40 - $1.75 / sf	Upgrade	$ 2,310	$ 2,888	$ 2,599
(3) Furnaces: 92% AFUE (from 80% AFUE)	Upgrade	$ 1,500	$ 3,600	$ 2,550
(3) Air Conditioners: 15 SEER, 12 EER (HERS) (from 13 SEER, 11 EER)	Upgrade	$ 1,500	$ 4,500	$ 3,000
(3) Air Conditioners: Refrig. Charge (HERS)	-	$ -	$ -	$ -
R-8 Attic Ducts	-	$ -	$ -	$ -
Reduced Duct Leakage/Testing (HERS)	-	$ -	$ -	$ -
(3) Instantaneous Gas Water Heater: RE=0.82 (from (3) 50 Gal Gas: EF=0.60)	Upgrade	$ 3,600	$ 6,000	$ 4,800
Pipe Insulation	Upgrade	$ 450	$ 600	$ 525
Solar Photovoltaic (PV) System: 4 KW	Upgrade	$ 18,000	$ 26,000	$ 22,000
Total Incremental Cost of Energy Efficiency Measures:		**$ 31,512**	**$ 49,809**	**$ 40,660**
Total Incremental Cost per Square Foot:		**$ 4.20**	**$ 6.64**	**$ 5.42**

CLIMATE ZONE 3

The following energy design descriptions of single family building prototypes just meet the 2008 Title 24 Building Energy Efficiency Standards in **Climate Zone 3:**

CZ3: Single Family House 1,582 square feet, 2-story, 14.3% glazing/floor area ratio

Energy Efficiency Measures to Meet Title 24
R-38 Roof w/ Radiant Barrier
R-13 Walls
R-19 Raised Floor
Low E2 Vinyl Windows, U=0.36, SHGC=0.30; no overhangs
Furnace: 80% AFUE; No Cooling
R-6 Attic Ducts
50 gallon Gas DHW: EF=0.58; no extra pipe insulation

CZ3: Single Family House 2,025 square feet, 2-story, 20.2% glazing/floor area ratio

Energy Efficiency Measures to Meet Title 24
R-38 Roof w/ Radiant Barrier
R-13 Walls
R-19 Raised Floor
Low E2 Vinyl Windows, U=0.40, SHGC=0.40; no overhangs
Furnace: 80% AFUE; No Cooling
R-6 Attic Ducts
50 gallon Gas DHW: EF=0.62; no extra pipe insulation

CZ3: Single Family House 5,000 square feet, 2-story, 22.0% glazing/floor area ratio

Energy Efficiency Measures
R-30 Roof w/ Radiant Barrier
R-13 Walls
R-19 Raised Floor
Low E2 Vinyl Windows, U=0.36, SHGC=0.30
(2) Furnaces: 80% AFUE
Air Conditioners: None
R-8 Attic Ducts
Reduced Duct Leakage/Testing (HERS)
(2) 50 Gallon Gas Water Heaters: EF=0.60

CZ3: Single Family House 6,500 square feet, 2-story, 22.0% glazing/floor area ratio

Energy Efficiency Measures
R-30 Roof w/ Radiant Barrier
R-13 Walls
R-19 Raised Floor
Quality Insulation Installation (HERS)
Low E2 Vinyl Windows, U=0.36, SHGC=0.30
(3) Furnaces: 80% AFUE
Air Conditioners: None
R-8 Attic Ducts
Reduced Duct Leakage/Testing (HERS)
(3) 50 Gallon Gas Water Heaters: EF=0.60

CZ3: Single Family House 7,500 square feet, 2-story, 22.0% glazing/floor area ratio

Energy Efficiency Measures
R-30 Roof w/ Radiant Barrier
R-13 Walls
R-19 Raised Floor
Quality Insulation Installation (HERS)
Low E2 Vinyl Windows, U=0.36, SHGC=0.30
(3) Furnaces: 80% AFUE
Air Conditioners: None
R-6 Attic Ducts
Reduced Duct Leakage/Testing (HERS)
(3) 50 Gallon Gas Water Heaters: EF=0.60

Climate Zone 3 Energy Efficiency Measures Needed to Meet the Ordinance

The following tables list the energy features and/or equipment included in the Title 24 base design, the efficient measure options, and an estimate of the incremental cost for each measure included **to improve the building performance to use 15% less TDV energy than the corresponding Title 24 base case design** (except homes equal or greater than 4,000 square feet as indicated).

Incremental Cost Estimate to Exceed Title 24 by 15%
Single Family Prototype: 1,582 SF, Option 1 **Climate Zone 3**

Energy Efficiency Measures to Exceed Title 24 by 15%	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
Furnace: 92% AFUE	Upgrade	$ 500	$ 1,200	$ 850
Reduced Duct Leakage/Testing (HERS)	Upgrade	$ 300	$ 600	$ 450
House wrap: 1,116 sf @ $0.08 to $0.12/sf	Upgrade	$ 90	$ 135	$ 113
R-49 roof insulation: 1,582 sf $0.19 to $0.22/sf	Upgrade	$ 300	$ 350	$ 325
50 gallon DHW: EF=0.62 (from EF=0.58)	Upgrade	$ 100	$ 200	$ 150
R-15 Wall Insulation: 1,116 sf @ $0.06 to $0.08/sf	-	$ -	$ -	$ -
All DHW Pipe Insulation	-	$ -	$ -	$ -
Total Incremental Cost of Energy Efficiency Measures:		**$ 1,290**	**$ 2,485**	**$ 1,888**
Total Incremental Cost per Square Foot:		**$ 0.82**	**$ 1.57**	**$ 1.19**

Incremental Cost Estimate to Exceed Title 24 by 15%
Single Family Prototype: 2,025 SF, Option 1 **Climate Zone 3**

Energy Efficiency Measures to Exceed Title 24 by 15%	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
Furnace: 92% AFUE	Upgrade	$ 500	$ 1,200	$ 850
Reduced Duct Leakage/Testing (HERS)	Upgrade	$ 300	$ 600	$ 450
House wrap: 1,116 sf @ $0.08 to $0.12/sf	Upgrade	$ 205	$ 305	$ 255
R-49 roof insulation: 1,443 sf $0.19 to $0.22/sf	-	$ -	$ -	$ -
50 gallon DHW: EF=0.62 (from EF=0.58)	-	$ -	$ -	$ -
R-15 Wall Insulation: 2,550 sf @ $0.06 to $0.08/sf	-	$ -	$ -	$ -
All DHW Pipe Insulation	-	$ -	$ -	$ -
Total Incremental Cost of Energy Efficiency Measures:		**$ 1,005**	**$ 2,105**	**$ 1,555**
Total Incremental Cost per Square Foot:		**$ 0.50**	**$ 1.04**	**$ 0.77**

For homes ≥ 4,000 square feet to 5,499 square feet, the following tables list the energy measures needed to improve a 5,000 square foot home so that it uses at least 20% less TDV energy than the corresponding Title 24 base case design.

Incremental Cost Estimate to Exceed Title 24 by 20%
Single Family Prototype: 5,000 SF, Option 1 **5000 sf** **Climate Zone 3**

Energy Efficiency Measures	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-30 Roof w/ Radiant Barrier	-	$ -	$ -	$ -
R-21 Walls (from R-13): 2,616 sf @ $0.45 to $0.70/sf	Upgrade	$ 1,177	$ 1,831	$ 1,504
R-19 Raised Floor	-	$ -	$ -	$ -
Quality Insulation Installation (HERS)	Upgrade	$ 450	$ 600	$ 525
Low E2 Vinyl Windows, U=0.36, SHGC=0.30	-	$ -	$ -	$ -
(2) Furnaces: 92% AFUE (from 80% AFUE)	Upgrade	$ 1,000	$ 2,400	$ 1,700
Air Conditioners: None	-	$ -	$ -	$ -
R-8 Attic Ducts	-	$ -	$ -	$ -
Reduced Duct Leakage/Testing (HERS)	-	$ -	$ -	$ -
(2) 50 Gallon Gas Water Heaters: EF=0.62 (from EF=0.60)	Upgrade	$ 200	$ 400	$ 300
Total Incremental Cost of Energy Efficiency Measures:		**$ 2,827**	**$ 5,231**	**$ 4,029**
Total Incremental Cost per Square Foot:		**$ 0.57**	**$ 1.05**	**$ 0.81**

Incremental Cost Estimate to Exceed Title 24 by 20%
Single Family Prototype: 5,000 SF, Option 2 **5000 sf** **Climate Zone 3**

Energy Efficiency Measures	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-30 Roof w/ Radiant Barrier	-	$ -	$ -	$ -
R-19 Walls (from R-13): 2,616 sf @ $0.31 to $0.54/sf	Upgrade	$ 811	$ 1,413	$ 1,112
R-19 Raised Floor	-	$ -	$ -	$ -
Low E2 Vinyl Windows, U=0.36, SHGC=0.30	-	$ -	$ -	$ -
(2) Furnaces: 80% AFUE	-	$ -	$ -	$ -
Air Conditioners: None	-	$ -	$ -	$ -
R-6 Attic Ducts (from R-8)	Downgrade	$ (650)	$ (450)	$ (550)
Reduced Duct Leakage/Testing (HERS)	-	$ -	$ -	$ -
(2) Instantaneous Gas Water Heater: RE=0.80 (from (2) 50 Gal Gas: EF=0.60)	Upgrade	$ 2,000	$ 3,400	$ 2,700
Total Incremental Cost of Energy Efficiency Measures:		**$ 2,161**	**$ 4,363**	**$ 3,262**
Total Incremental Cost per Square Foot:		**$ 0.43**	**$ 0.87**	**$ 0.65**

For homes ≥ 5,500 square feet to 6,999 square feet, the following tables list the energy measures needed to improve a 6,500 square foot home so that it uses at least 30% less TDV energy than the corresponding Title 24 base case design.

Incremental Cost Estimate to Exceed Title 24 by 20%
Single Family Prototype: 6,500 SF, Option 1 **6500 sf** **Climate Zone 3**

Energy Efficiency Measures	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-38 Roof w/ Radiant Barrier (from R-30 w/Radiant Barrier): 3,900 sf @ 0.15 to 0.20/sf	Upgrade	$ 585	$ 780	$ 683
R-21 Walls (from R-13): 2,808 sf @ $0.45 to $0.70/sf	Upgrade	$ 1,264	$ 1,966	$ 1,615
R-30 Raised Floor (from R-19): 3,900 sf @ $0.25 to $0.35	Upgrade	$ 975	$ 1,365	$ 1,170
Quality Insulation Installation (HERS)	-	$ -	$ -	$ -
Low E2 Vinyl Windows, U=0.36, SHGC=0.30	-	$ -	$ -	$ -
(3) Furnaces: 80% AFUE	-	$ -	$ -	$ -
Air Conditioners: None	-	$ -	$ -	$ -
R-8 Attic Ducts	-	$ -	$ -	$ -
Reduced Duct Leakage/Testing (HERS)	-	$ -	$ -	$ -
(3) Instantaneous Gas Water Heater: RE=0.80 (from (3) 50 Gal Gas: EF=0.60)	Upgrade	$ 3,000	$ 5,100	$ 4,050
Pipe Insulation	Upgrade	$ 450	$ 600	$ 525
Total Incremental Cost of Energy Efficiency Measures:		**$ 6,274**	**$ 9,811**	**$ 8,042**
Total Incremental Cost per Square Foot:		**$ 0.97**	**$ 1.51**	**$ 1.24**

Incremental Cost Estimate to Exceed Title 24 by 20%
Single Family Prototype: 6,500 SF, Option 2 **6500 sf** **Climate Zone 3**

Energy Efficiency Measures	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-30 Roof w/ Radiant Barrier	-	$ -	$ -	$ -
R-19 Walls (from R-13): 2,808 sf @ $0.31 to $0.54/sf	Upgrade	$ 870	$ 1,516	$ 1,193
R-19 Raised Floor	-	$ -	$ -	$ -
Quality Insulation Installation (HERS)	-	$ -	$ -	$ -
Low E2 Vinyl Windows, U=0.36, SHGC=0.30	-	$ -	$ -	$ -
(3) Furnaces: 92% AFUE (from 80% AFUE)	Upgrade	$ 1,500	$ 3,600	$ 2,550
Air Conditioners: None	-	$ -	$ -	$ -
R-8 Attic Ducts	-	$ -	$ -	$ -
Reduced Duct Leakage/Testing (HERS)	-	$ -	$ -	$ -
(3) Instantaneous Gas Water Heater: RE=0.80 (from (3) 50 Gal Gas: EF=0.60)	Upgrade	$ 3,000	$ 5,100	$ 4,050
Total Incremental Cost of Energy Efficiency Measures:		**$ 5,370**	**$ 10,216**	**$ 7,793**
Total Incremental Cost per Square Foot:		**$ 0.83**	**$ 1.57**	**$ 1.20**

For homes ≥ 7,000 square feet the following tables list the energy measures needed to improve a 7,500 square foot home so that its net Title 24 TDV energy use is zero (i.e. Net Zero TDV Energy) as compared with the corresponding Title 24 base case design. To achieve this level of performance, a solar PV system is added to the home sized to just meet the Net Zero Energy threshold by rounding up to the next largest whole KW of nominal solar PV capacity.

Incremental Cost Estimate to Exceed Title 24 by 20%
Single Family Prototype: 7,500 SF, Option 1 **7500 sf** **Climate Zone 3**

Energy Efficiency Measures	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-38 Roof w/ Radiant Barrier (from R-30 w/Radiant Barrier): 4,500 sf @ 0.15 to 0.20/sf	Upgrade	$ 675	$ 900	$ 788
R-21 Walls (from R-13): 2,904 sf @ $0.45 to $0.70/sf	Upgrade	$ 1,307	$ 2,033	$ 1,670
R-30 Raised Floor (from R-19): 4,500 sf @ $0.25 to $0.35	Upgrade	$ 1,125	$ 1,575	$ 1,350
Quality Insulation Installation (HERS)	-	$ -	$ -	$ -
Housewrap: 2,904 sf @ $0.50 to $0.75/sf	Upgrade	$ 1,452	$ 2,178	$ 1,815
Low E2 Vinyl Windows, U=0.36, SHGC=0.30	-	$ -	$ -	$ -
(3) Furnaces: 92% AFUE (from 80% AFUE)	Upgrade	$ 1,500	$ 3,600	$ 2,550
Air Conditioners: None	-	$ -	$ -	$ -
R-6 Attic Ducts	-	$ -	$ -	$ -
Reduced Duct Leakage/Testing (HERS)	-	$ -	$ -	$ -
(3) Instantaneous Gas Water Heater: RE=0.82 (from (3) 50 Gal Gas: EF=0.60)	Upgrade	$ 3,600	$ 6,000	$ 4,800
Solar Photovoltaic (PV) System: 2 KW	Upgrade	$ 9,000	$ 13,000	$ 11,000
Total Incremental Cost of Energy Efficiency Measures:		**$ 18,659**	**$ 29,286**	**$ 23,972**
Total Incremental Cost per Square Foot:		**$ 2.49**	**$ 3.90**	**$ 3.20**

Incremental Cost Estimate to Exceed Title 24 by 20%
Single Family Prototype: 7,500 SF, Option 2 **7500 sf** **Climate Zone 3**

Energy Efficiency Measures	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-38 Roof w/ Radiant Barrier (from R-30 w/Radiant Barrier): 4,500 sf @ 0.15 to 0.20/sf	Upgrade	$ 675	$ 900	$ 788
R-21 Walls (from R-13): 2,904 sf @ $0.45 to $0.70/sf	Upgrade	$ 1,307	$ 2,033	$ 1,670
R-38 Raised Floor (from R-19): 4,500 sf @ $0.30 to $0.45	Upgrade	$ 1,350	$ 2,025	$ 1,688
Quality Insulation Installation (HERS)	-	$ -	$ -	$ -
Low E2 Vinyl Windows, U=0.36, SHGC=0.30	-	$ -	$ -	$ -
(3) Furnaces: 94% AFUE (from 80% AFUE)	Upgrade	$ 2,700	$ 5,400	$ 4,050
Air Conditioners: None	-	$ -	$ -	$ -
R-8 Attic Ducts (from R-6)	Upgrade	$ -	$ -	$ -
Reduced Duct Leakage/Testing (HERS)	-	$ -	$ -	$ -
(3) Instantaneous Gas Water Heater: RE=0.84 (from (3) 50 Gal Gas: EF=0.60)	Upgrade	$ 4,200	$ 7,200	$ 5,700
Pipe Insulation	Upgrade	$ 450	$ 600	$ 525
Solar Photovoltaic (PV) System: 2 KW	Upgrade	$ 9,000	$ 13,000	$ 11,000
Total Incremental Cost of Energy Efficiency Measures:		**$ 19,682**	**$ 31,158**	**$ 25,420**
Total Incremental Cost per Square Foot:		**$ 2.62**	**$ 4.15**	**$ 3.39**

2.2 Low-rise Multi-family Residential Building

The following is the energy design description of the low-rise multifamily building prototype which just meets the 2008 Title 24 Building Energy Efficiency Standards:

CZ2: Low-rise Multi-family: 2-story 8,442 square feet, 8 units, 12.5% glazing

Energy Efficiency Measures
R-38 Roof w/ Radiant Barrier
R-15 Walls
R-0 Slab on Grade
Low E2 Vinyl Windows, U=0.36, SHGC=0.30
(8) Furnaces: 80% AFUE
(8) Air Conditioners: 13 SEER
R-8 Attic Ducts
(8) 40 Gallon Gas Water Heaters: EF=0.63

CZ3: Low-rise Multi-family: 2-story 8,442 square feet, 8 units, 12.5% glazing

Energy Efficiency Measures to Meet Title 24
R-38 Roof w/ Radiant Barrier
R-13 Walls
Slab-on-grade 1st floor
Low E2 Vinyl Windows, U=0.39, SHGC=0.33; no overhangs
Furnace: 80% AFUE; No Cooling
R-6 Attic Ducts
50 gallon Gas DHW: EF=0.575; no extra pipe insulation

Climate Zone 2 Energy Measures Needed to Meet the Ordinance

See Section 2.0 for the description of the approach used to establish which energy measures are used to meet the proposed Ordinance for this prototype building design.

Incremental Cost Estimate to Exceed Title 24 by 15%
Low-rise Multifamily Prototype: 8,442 SF, Option 1 **8442 sf** **Climate Zone 2**

Energy Efficiency Measures	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-38 Roof w/ Radiant Barrier	-	$ -	$ -	$ -
R-21 Walls (from R-15): 10,146 sf @ $0.50 to $0.75/sf	Upgrade	$ 5,073	$ 7,510	$ 6,292
R-0 Slab on Grade	-	$ -	$ -	$ -
Low E2 Vinyl Windows, U=0.36, SHGC=0.30	-	$ -	$ -	$ -
(8) Furnaces: 80% AFUE	-	$ -	$ -	$ -
(8) Air Conditioner: 13 SEER, 11 EER (HERS)	Upgrade	$ 200	$ 600	$ 400
(8) Air Conditioner: Refrig. Charge (HERS)	Upgrade	$ 1,200	$ 1,600	$ 1,400
R-8 Attic Ducts	-	$ -	$ -	$ -
(8) 40 Gallon Gas Water Heaters: EF=0.63	-	$ -	$ -	$ -
Total Incremental Cost of Energy Efficiency Measures:		**$ 6,473**	**$ 9,710**	**$ 8,092**
Total Incremental Cost per Square Foot:		**$ 0.77**	**$ 1.15**	**$ 0.96**

Incremental Cost Estimate to Exceed Title 24 by 15%
Low-rise Multifamily Prototype: 8,442 SF, Option 2 **8442 sf** **Climate Zone 2**

Energy Efficiency Measures	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-38 Roof w/ Radiant Barrier	-	$ -	$ -	$ -
R-19 Walls (from R-15): 10,146 sf @ $0.45 to $0.75/sf	Upgrade	$ 4,566	$ 7,610	$ 6,088
R-0 Slab on Grade	-	$ -	$ -	$ -
Low E2 Vinyl Windows, U=0.36, SHGC=0.30	-	$ -	$ -	$ -
(8) Furnaces: 80% AFUE	-	$ -	$ -	$ -
(8) Air Conditioners: 13 SEER	-	$ -	$ -	$ -
R-4.2 Attic Ducts (from R-8)	Downgrade	$ (3,000)	$ (2,000)	$ (2,500)
Reduced Duct Leakage/Testing (HERS)	Upgrade	$ 2,000	$ 4,000	$ 3,000
(8) 40 Gallon Gas Water Heaters: EF=0.62 (from 0.63 EF)	Downgrade	$ -	$ (400)	$ (200)
Total Incremental Cost of Energy Efficiency Measures:		**$ 3,566**	**$ 9,210**	**$ 6,388**
Total Incremental Cost per Square Foot:		**$ 0.42**	**$ 1.09**	**$ 0.76**

Climate Zone 3 Energy Measures Needed to Meet the Ordinance

Incremental Cost Estimate to Exceed Title 24 by 15%
Multifamily Prototype: 8,442 SF, Option 1 **Climate Zone 3**

Energy Efficiency Measures to Exceed Title 24 by 15%	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
Furnace: (8) @ 92% AFUE	Upgrade	$ 4,000	$ 9,600	$ 6,800
Reduced Duct Leakage/Testing (HERS)	Upgrade	$ 2,000	$ 4,000	$ 3,000
House wrap: 9,266 sf @ $0.08 to $0.12/sf	Upgrade	$ 745	$ 1,115	$ 930
R-49 roof insulation: 2,880 sf $0.19 to $0.22/sf	Upgrade	$ 550	$ 635	$ 593
50 gallon DHW: EF=0.62 (from EF=0.58)	-	$ -	$ -	$ -
R-15 Wall Insulation: 9,266 sf @ $0.06 to $0.08/sf	Upgrade	$ 560	$ 745	$ 653
All DHW Pipe Insulation	-	$ -	$ -	$ -
Total Incremental Cost of Energy Efficiency Measures:		**$ 7,855**	**$ 16,095**	**$ 11,975**
Total Incremental Cost per Square Foot:		**$ 0.93**	**$ 1.91**	**$ 1.42**

2.3 High-rise Multifamily Building

The following is the energy design description of the high-rise multifamily building prototype which just meets the 2008 Title 24 Building Energy Efficiency Standards:

CZ2: High-rise Residential: 4-story 36,800 sf, 40 units, Window Wall Ratio=35.2%

Energy Efficiency Measures to Meet Title 24
R-30 Attic; Cool Roof Reflectance=0.70, Emittance=0.75
R-19 in Metal Frame Walls
R-6 (2" K-13 spray-on) Raised Slab over parking garage
Vinyl Windows, NFRC U=0.36, SHGC=0.35
Split Heat Pumps: HSPF=7.2, EER=10.2
Central DHW boiler: 82.7% AFUE and recirculating system w/ timer-temperature controls & VSD hot water pump

CZ3: High-rise Residential: 4-story 36,800 sf, 40 units, Window Wall Ratio=35.2%

Energy Efficiency Measures to Meet Title 24
R-30 Attic w/ Cool Roof Reflectance=0.30, Emittance=0.75
R-19 in Metal Frame Walls
R-0 (un-insulated) raised slab over parking garage
Low E2 Vinyl Windows, U=0.33, SHGC=0.30 *(see Note 1)*
Split heat pumps: HSPF=7.2, EER=10.2
Central domestic DHW boiler: 82.7% AFUE and recirculating system w/ timer-temperature controls & VSD hot water pump

Note 1: Includes a small amount of fixed overhangs above first floor front fenestration

CZ 2: Energy Measures Needed to Meet the County's Ordinance

Incremental Cost Estimate to Exceed Title 24 by 15%
High-rise Residential Prototype: 36,800 SF, Option 1 **Climate Zone 2**

Energy Efficiency Measures to Exceed Title 24 by 15%	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-30 Attic; Cool Roof Reflectance=0.70, Emittance=0.75	-	$ -	$ -	$ -
R-19 in Metal Frame Walls	-	$ -	$ -	$ -
R-8 (2.5" K-13 spray-on) Raised Slab over parking garage	Upgrade	$ 3,680	$ 5,520	$ 4,600
Vinyl Windows, NFRC U=0.33, SHGC=0.25; 6,240 sf @ $1.40 to $1.60/sf	Upgrade	$ 8,736	$ 9,984	$ 9,360
(80) Room Heat Pumps: HSPF=7.84, eer=11.2 (No Ducts) @ $150 to $250/unit	Upgrade	$ 12,000	$ 20,000	$ 16,000
Premium Efficiency DHW Hot Water Pump	Upgrade	$ 150	$ 250	$ 200
Total Incremental Cost of Energy Efficiency Measures:		**$ 24,566**	**$ 35,754**	**$ 30,160**
Total Incremental Cost per Square Foot:		**$ 0.67**	**$ 0.97**	**$ 0.82**

Incremental Cost Estimate to Exceed Title 24 by 15%
High-rise Residential Prototype: 36,800 SF, Option 2 **Climate Zone 2**

Energy Efficiency Measures to Exceed Title 24 by 15%	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-30 Attic; Cool Roof Reflectance=0.70, Emittance=0.75	-	$ -	$ -	$ -
R-19 in Metal Frame Walls + R-5 exterior rigid insulation 11,472 sf @ $5.00 to $8.00/sf	Upgrade	$ 57,360	$ 91,776	$ 74,568
R-6 (2" K-13 spray-on) Raised Slab over parking garage	-	$ -	$ -	$ -
Vinyl Windows, NFRC U=0.33, SHGC=0.25; 6,240 sf @ $1.40 to $1.60/sf	Upgrade	$ 8,736	$ 9,984	$ 9,360
Split Heat Pumps: HSPF=7.2, EER=10.2	-	$ -	$ -	$ -
(2) 94% AFUE DHW boilers @ $1500 to$2500 each	Upgrade	$ 3,000	$ 5,000	$ 4,000
Total Incremental Cost of Energy Efficiency Measures:		**$ 69,096**	**$106,760**	**$ 87,928**
Total Incremental Cost per Square Foot:		**$ 1.88**	**$ 2.90**	**$ 2.39**

CZ 3: Energy Measures Needed to Meet the County's Ordinance

See Section 2.1 for the description of the approach used to establish which energy measures are used to meet the proposed Ordinance for this prototype building design.

Incremental Cost Estimate to Exceed Title 24 by 15%
High-rise Residential Prototype: 36,800 SF, Option 1 **Climate Zone 3**

Energy Efficiency Measures to Exceed Title 24 by 15%	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-30 Attic; Cool Roof Reflectance=0.30, Emittance=0.75	-	$ -	$ -	$ -
R-19 in Metal Frame Walls	-	$ -	$ -	$ -
R-3 (1" K-13 spray-on) Raised Slab over parking garage 9,200 sf @1.20 to $1.50 sf	Upgrade	$ 11,040	$ 13,800	$ 12,420
Vinyl Windows, NFRC U=0.33, SHGC=0.23; 6,240 sf @ $1.40 to $1.60/sf	Upgrade	$ 8,425	$ 9,360	$ 8,893
(80) Room Heat Pumps: HSPF=7.84, eer=11.2 (No Ducts) @ $150 to $250/unit	Upgrade	$ 12,000	$ 20,000	$ 16,000
(2) 94% AFUE DHW boilers @ $1500 to$2500 each	Upgrade	$ 3,000	$ 5,000	$ 4,000
Total Incremental Cost of Energy Efficiency Measures:		**$ 34,465**	**$ 48,160**	**$ 41,313**
Total Incremental Cost per Square Foot:		**$ 0.94**	**$ 1.31**	**$ 1.12**

2.4 Nonresidential Buildings

The following is the energy design description of the nonresidential building prototypes which just meet the 2008 Title 24 Building Energy Efficiency Standards:

CLIMATE ZONE 2

The following energy design descriptions of nonresidential building prototypes just meet the 2008 Title 24 Building Energy Efficiency Standards in **Climate Zone 2:**

CZ2: Nonresidential 2-story office building: 21,160 sf, Window Wall Ratio= 37.1%

Energy Efficiency Measures to Meet Title 24
R-38 Attic w/ No Cool Roof
R-19 in Metal Frame Walls
R-0 (un-insulated) slab-on-grade 1st floor
Windows NFRC U=0.50 and SHGCc=0.38, no exterior shading
(248) 2-lamp 4' T8 fixtures, 62w each; and (104) 26w CFLs @ 26w each; no lighting controls (beyond mandatory)
(4) 10-ton Packaged DX units EER=11.0, 4,000 cfm; and (4) 7.5-ton Packaged DX units EER=11.0, 3,000 cfm; all standard efficiency fan motors
R-4.2 duct insulation w/ ducts in conditioned space
Standard 50 gallon gas water heater, EF=0.575

CZ2: Nonresidential 5-story office building: 52,900 sf, Window Wall Ratio= 29.1%

Energy Efficiency Measures to Meet Title 24
R-38 Attic w/ No Cool Roof
R-19 in Metal Frame Walls
R-0 (un-insulated) slab-on-grade 1st floor
Windows NFRC U=0.50 and SHGCc=0.31, 2' overhang 1st floor front elevation only
(720) 2-lamp 4' T8 fixtures w/ high efficiency instant start ballasts & premium lamps, 50w; and (300) 18w CFLs @ 18w each; no lighting controls (beyond mandatory)
(5) 30-ton Packaged VAV units EER=10.4, 10,000 cfm; 20% VAV boxes w/ reheat; all standard efficiency fan motors
R-4.2 duct insulation w/ ducts in conditioned space
Standard hot water boiler, AFUE=80%

CZ2: Nonresidential 2-story office building: 21,160 sf, Window Wall Ratio= 37.1%

Incremental Cost Estimate to Exceed Title 24 by 15%
Nonresidential Prototype: 21,160 SF, Option 1 **Climate Zone 2**

Energy Efficiency Measures to Exceed Title 24 by 15%	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-38 Attic w/ No Cool Roof	-	$ -	$ -	$ -
R-19 in Metal Frame Walls	-	$ -	$ -	$ -
R-0 (un-insulated) slab-on-grade 1st floor				
Windows, NFRC U=0.50, SHGC=0.31; 5,160 sf @ $2.00 to $3.00/sf	Upgrade	$ 10,320	$ 15,480	$ 12,900
(248) 2-lamp 4' T8 fixtures w/ high efficiency instant start ballasts & premium lamps, 50w @ $25.00 - $30.00 each	Upgrade	$ 6,000	$ 7,200	$ 6,600
(4) 10-ton Packaged DX units, EER= 13.4 @ $2300 - $2600 ea,	Upgrade	$ 16,000	$ 24,000	$ 20,000
(4) 7.5-ton Packaged DX units, EER= 13.4 @ $1950 - $2450 ea,	Upgrade	$ 12,000	$ 18,800	$ 15,400
(8) Premium Efficiency supply fans @ $100 to $200 each	Upgrade	$ 800	$ 1,600	$ 1,200
R-4.2 duct insulation w/ ducts in conditioned space	-	$ -	$ -	$ -
Standard 50 gallon gas water heater, EF=0.575	-	$ -	$ -	$ -
Total Incremental Cost of Energy Efficiency Measures:		**$ 45,120**	**$ 67,080**	**$ 56,100**
Total Incremental Cost per Square Foot:		**$ 2.13**	**$ 3.17**	**$ 2.65**

Incremental Cost Estimate to Exceed Title 24 by 15%
Nonresidential Prototype: 21,160 SF, Option 2 **Climate Zone 2**

Energy Efficiency Measures to Exceed Title 24 by 15%	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-38 Attic w/ No Cool Roof	-	$ -	$ -	$ -
R-19 in Metal Frame Walls + R-6.5 (1") rigid insulation 8,752 sf @ $3.00 to $4.00/sf	-	$ 26,256	$ 35,008	$ 30,632
R-0 (un-insulated) slab-on-grade 1st floor				
Windows, NFRC U=0.50, SHGC=0.28; 5,160 sf @ $3.50 to $4.50/sf	Upgrade	$ 18,060	$ 23,220	$ 20,640
(72) [30% of] 2-lamp 4' T8 fixtures on (36) multi-level occupant sensors in small offices @ $65.00 to $85.00 each	Upgrade	$ 2,340	$ 3,060	$ 2,700
(248) 2-lamp 4' T8 fixtures w/ high efficiency instant start ballasts & premium lamps, 50w @ $25.00 - $30.00 each	Upgrade	$ 6,000	$ 7,200	$ 6,600
(4) 10-ton Packaged DX units EER=11.0, 4,000 cfm; and (4) 7.5-ton Packaged DX units EER=11.0, 3,000 cfm; all standard efficiency fan motors	-	$ -	$ -	$ -
R-4.2 duct insulation w/ ducts in conditioned space	-	$ -	$ -	$ -
Standard 50 gallon gas water heater, EF=0.575	-	$ -	$ -	$ -
Total Incremental Cost of Energy Efficiency Measures:		**$ 52,656**	**$ 68,488**	**$ 60,572**
Total Incremental Cost per Square Foot:		**$ 2.49**	**$ 3.24**	**$ 2.86**

CZ2: Nonresidential 5-story office building: 52,900 sf, Window Wall Ratio= 29.1%

Energy Efficiency Measures to Exceed Title 24 by 15%	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-38 Attic w/ Cool Roof Reflectance=0.70, Emittance=0.75 10,580 sf @ $0.40 to $0.60/sf	Upgrade	$ 4,235	$ 6,348	$ 5,292
R-19 in Metal Frame Walls	-	$ -	$ -	$ -
R-0 (un-insulated) slab-on-grade 1st floor				
Windows, NFRC U=0.50, SHGC=0.31; 5,160 sf @ $2.00 to $3.00/sf	-	$ -	$ -	$ -
(180) [25% of] 2-lamp 4' T8 fixtures on (90) multi-level occupant sensors in small offices @ $65.00 to $85.00 each	Upgrade	$ 5,850	$ 7,650	$ 6,750
(5) 10-ton Packaged DX units, EER= 11.0 w/ Premium fan motors @ $10,800 to $15,600 ea,	Upgrade	$ 54,000	$ 78,000	$ 66,000
R-4.2 duct insulation w/ ducts in conditioned space	-	$ -	$ -	$ -
Standard hot water boiler, AFUE=80%	-	$ -	$ -	$ -
Total Incremental Cost of Energy Efficiency Measures:		**$ 59,850**	**$ 85,650**	**$ 72,750**
Total Incremental Cost per Square Foot:		**$ 1.13**	**$ 1.62**	**$ 1.38**

Incremental Cost Estimate to Exceed Title 24 by 15%
Nonresidential Prototype: 52,900 SF, Option 2 **Climate Zone 2**

Energy Efficiency Measures to Exceed Title 24 by 15%	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-38 Attic w/ Cool Roof Reflectance=0.70, Emittance=0.75 10,580 sf @ $0.40 to $0.60/sf	Upgrade	$ 4,235	$ 6,348	$ 5,292
R-19 in Metal Frame Walls + R-6.5 (1") rigid insulation 8,752 sf @ $3.00 to $4.00/sf	Upgrade	$ 26,256	$ 35,008	$ 30,632
R-0 (un-insulated) slab-on-grade 1st floor				
Windows, NFRC U=0.50, SHGC=0.28; 8,500 sf @ $2.00 to $3.00/sf	Upgrade	$ 17,000	$ 25,500	$ 21,250
(180) [25% of] 2-lamp 4' T8 fixtures on (90) multi-level occupant sensors in small offices @ $65.00 to $85.00 each	Upgrade	$ 5,850	$ 7,650	$ 6,750
(248) 2-lamp 4' T8 fixtures w/ high efficiency instant start ballasts & premium lamps, 50w @ $25.00 - $30.00 each	Upgrade	$ 6,000	$ 7,200	$ 6,600
(5) 30-ton Packaged VAV units EER=10.4, 10,000 cfm; 20% VAV boxes w/ reheat; (10) Premium Effiiciency fan motors	Upgrade	$ 1,000	$ 1,500	$ 1,250
R-4.2 duct insulation w/ ducts in conditioned space	-	$ -	$ -	$ -
Standard hot water boiler, AFUE=80%	-	$ -	$ -	$ -
Total Incremental Cost of Energy Efficiency Measures:		**$ 56,106**	**$ 76,858**	**$ 66,482**
Total Incremental Cost per Square Foot:		**$ 1.06**	**$ 1.45**	**$ 1.26**

CLIMATE ZONE 3

The following energy design descriptions of nonresidential building prototypes just meet the 2008 Title 24 Building Energy Efficiency Standards in **Climate Zone 3:**

CZ3: Nonresidential 2-story office building: 21,160 sf, Window Wall Ratio= 37.1%

Energy Efficiency Measures to Meet Title 24
R-38 Attic w/ No Cool Roof
R-19 in Metal Frame Walls
R-0 (un-insulated) slab-on-grade 1st floor
Windows NFRC U=0.50 and SHGCc=0.38, no exterior shading
(248) 2-lamp 4' T8 fixtures, 62w each; and (104) 26w CFLs
@ 26w each; no lighting controls (beyond mandatory)
(4) 10-ton Packaged DX units EER=11.0, 4,000 cfm; and
(4) 7.5-ton Packaged DX units EER=11.0, 3,000 cfm;
all standard efficiency fan motors
R-4.2 duct insulation w/ ducts in conditioned space
Standard 50 gallon gas water heater, EF=0.575

CZ3: Nonresidential 5-story office building: 52,900 sf, Window Wall Ratio= 29.1%

Energy Efficiency Measures to Meet Title 24
R-30 Attic w/ No Cool Roof
R-19 in Metal Frame Walls
R-0 (un-insulated) slab-on-grade 1st floor
Windows NFRC U=0.50 and SHGCc=0.38, no exterior shading
(720) 2-lamp 4' T8 fixtures w/ high efficiency instant start ballasts
& premium lamps, 50w; and (260) 26w CFLs @ 26w
each; no lighting controls (beyond mandatory)
(5) 30-ton Packaged VAV units EER=10.4, 10,000 cfm; 20% VAV
boxes w/ reheat; all standard efficiency fan motors
R-4.2 duct insulation w/ ducts in conditioned space
Standard hot water boiler, AFUE=80%

CZ3: Nonresidential 2-story office building: 21,160 sf, Window Wall Ratio= 37.1%

Incremental Cost Estimate to Exceed Title 24 by 15%

Nonresidential Prototype: 21,160 SF, Option 1 **Climate Zone 3**

Energy Efficiency Measures to Exceed Title 24 by 15%	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-38 Attic + R-10 rigid insulation w/ Cool Roof Reflectance = 0.70, Emittance = 0.75; 10,580 sf @ $1.75 to $2.35/sf	Upgrade	$ 18,515	$ 24,865	$ 21,690
R-19 in Metal Frame Walls	-	$ -	$ -	$ -
R-0 (un-insulated) slab-on-grade 1st floor				
Windows, NFRC U=0.50, SHGC=0.31; 5,160 sf @ $2.00 to $3.00/sf	Upgrade	$ 10,320	$ 15,480	$ 12,900
(248) 2-lamp 4' T8 fixtures w/ high efficiency instant start ballasts & premium lamps, 50w @ $25.00 - $30.00 each	Upgrade	$ 6,200	$ 7,440	$ 6,820
(64) [26% of] 2-lamp 4' T8 fixtures on (32) multi-level occupant sensors in small offices @ $65.00 to $85.00 each	Upgrade	$ 2,080	$ 2,720	$ 2,400
(24) additional recessed CFL fixtures w/ all CFLs 18w lamps @ $175 to $250 each	Upgrade	$ 4,200	$ 6,000	$ 5,100
(4) 10-ton Packaged DX units EER=11.0, 4,000 cfm; (4) 7.5-ton Packaged DX units EER=11.0, 3,000 cfm; and (8) Premium Efficiency fan motors @ $100 to $200 each	Upgrade	$ 800	$ 1,600	$ 1,200
R-4.2 duct insulation w/ ducts in conditioned space	-	$ -	$ -	$ -
Standard 50 gallon gas water heater, EF=0.575	-	$ -	$ -	$ -
Total Incremental Cost of Energy Efficiency Measures:		**$ 42,115**	**$ 58,105**	**$ 50,110**
Total Incremental Cost per Square Foot:		**$ 1.99**	**$ 2.75**	**$ 2.37**

CZ3: Nonresidential 5-story office building: 52,900 sf, Window Wall Ratio= 29.1%

Incremental Cost Estimate to Exceed Title 24 by 15%

Nonresidential Prototype: 52,900 SF, Option 1 **Climate Zone 3**

Energy Efficiency Measures to Exceed Title 24 by 15%	Change Type	Incremental Cost Estimate		
		Min	Max	Avg
R-30 Attic w/ No Cool Roof	-	$ -	$ -	$ -
R-19 in Metal Frame Walls	-	$ -	$ -	$ -
R-0 (un-insulated) slab-on-grade 1st floor				
Windows NFRC U=0.50 and SHGCc=0.38, no exterior shading	-	$ -	$ -	$ -
(720) 2-lamp 4' T8 fixtures w/ high efficiency instant start ballasts & premium lamps, 50w @ $25.00 - $30.00 each	Upgrade	$ 18,000	$ 21,600	$ 19,800
(240) 33% of] 2-lamp 4' T8 fixtures on (120) multi-level occupant sensors in small offices @ $65.00 to $85.00 each	Upgrade	$ 7,800	$ 10,200	$ 9,000
(40) additional recessed CFL fixtures w/ all CFLs 18w lamps @ $175 to $250 each	Upgrade	$ 7,000	$ 10,000	$ 8,500
(5) 10-ton Packaged DX units, EER= 11.0 w/ Premium fan motors @ $10,800 to $15,600 ea,	Upgrade	$ 54,000	$ 78,000	$ 66,000
R-4.2 duct insulation w/ ducts in conditioned space	-	$ -	$ -	$ -
Standard hot water boiler, AFUE=80%	-	$ -	$ -	$ -
Total Incremental Cost of Energy Efficiency Measures:		**$ 86,800**	**$119,800**	**$103,300**
Total Incremental Cost per Square Foot:		**$ 1.64**	**$ 2.26**	**$ 1.95**

3.0 Cost Effectiveness

The summary of results in this section are based upon the following assumptions:

- Annual site electricity (kWh) and natural gas (therms) saved are calculated using a beta version of the state-approved energy compliance software for the 2008 Building Energy Efficiency Standards, Micropas 8.

- Average utility rates of **$0.173/kWh** for electricity and **$1.15/therm** for natural gas in current constant dollars

- No change (i.e., no inflation or deflation) of utility rates in constant dollars

- No increase in summer temperatures from global climate change

The Simple Payback data includes a cost-effectiveness analysis of the Ordinance with respect to each case study building design and assumes:

- No external cost of global climate change -- and corresponding value of additional investment in energy efficiency and CO2 reduction – is included

- The cost of money (e.g, opportunity cost) invested in the incremental cost of energy efficiency measures is not included.

3.1 New Single Family Houses

Climate Zone 2: 15% Better Than Title 24

Single Family

Building Description	Total Annual KWh Saving	Total Annual Therms Saving	Incremental First Cost ($)	Annual Energy Cost Savings ($)	Simple Payback (Years)
2,025 sf (Option 1)	399	69	$2,011	$148	13.5
2,025 sf (Option 2)	348	81	$2,104	$153	13.7
Averages:	374	75	$2,057	$151	13.6

Annual Reduction in CO2-equivalent: 1,041 lb./building-year
0.51 lb./sq.ft.-year

Building Description	Total Annual KWh Saving	Total Annual Therms Saving	Incremental First Cost ($)	Annual Energy Cost Savings ($)	Simple Payback (Years)
2,682 sf (Option 1)	524	71	$2,072	$172	12.0
2,682 sf (Option 2)	338	111	$2,549	$186	13.7
2,682 sf (Option 3)	427	92	$2,327	$180	12.9
Averages:	430	91	$2,316	$179	12.9

Annual Reduction in CO2-equivalent: 1,256 lb./building-year
0.47 lb./sq.ft.-year

Climate Zone 3: 15% Better Than Title 24

Single Family

Building Description	Total Annual KWh Saving	Total Annual Therms Saving	Incremental First Cost ($)	Annual Energy Cost Savings ($)	Simple Payback (Years)
1,582 sf (Option 1)	63	67	$1,888	$88	21.5

Annual Reduction in CO2-equivalent: 808 lb./building-year
0.51 lb./sq.ft.-year

Building Description	Total Annual KWh Saving	Total Annual Therms Saving	Incremental First Cost ($)	Annual Energy Cost Savings ($)	Simple Payback (Years)
2,025 sf (Option 1)	81	88	$1,555	$115	13.5

Annual Reduction in CO2-equivalent: 1,061 lb./building-year
0.52 lb./sq.ft.-year

Climate Zone 2: 20% Better Than Title 24

Large Single Family

Building Description	Total Annual KWh Saving	Total Annual Therms Saving	Incremental First Cost ($)	Annual Energy Cost Savings ($)	Simple Payback (Years)
5,000 sf (Option 1)	908	129	$5,237	$305	17.1
5,000 sf (Option 2)	1040	116	$4,637	$313	14.8
5,000 sf (Option 3)	850	148	$5,087	$317	16.0
Averages:	933	131	$4,987	$312	16.0

Annual Reduction in CO2-equivalent: 1,945 lb./building-year
0.39 lb./sq.ft.-year

Climate Zone 3: 20% Better Than Title 24

Large Single Family

Building Description	Total Annual KWh Saving	Total Annual Therms Saving	Incremental First Cost ($)	Annual Energy Cost Savings ($)	Simple Payback (Years)
5,000 sf (Option 1)	171	146	$4,029	$197	20.4
5,000 sf (Option 2)	93	161	$3,262	$201	16.2
Averages:	132	154	$3,646	$199	18.3

Annual Reduction in CO2-equivalent: 1,846 lb./building-year
0.37 lb./sq.ft.-year

Climate Zone 2: 30% Better Than Title 24

Large Single Family

Building Description	Total Annual KWh Saving	Total Annual Therms Saving	Incremental First Cost ($)	Annual Energy Cost Savings ($)	Simple Payback (Years)
6,500 sf (Option 1)	1130	321	$12,020	$565	21.3
6,500 sf (Option 2)	1029	26	$9,253	$398	23.2
Averages:	1080	174	$10,636	$481	22.3

Annual Reduction in CO2-equivalent: 2,753 lb./building-year
0.42 lb./sq.ft.-year

Climate Zone 3: 30% Better Than Title 24

Large Single Family

Building Description	Total Annual KWh Saving	Total Annual Therms Saving	Incremental First Cost ($)	Annual Energy Cost Savings ($)	Simple Payback (Years)
6,500 sf (Option 1)	165	275	$8,043	$345	23.3
6,500 sf (Option 2)	95	281	$7,793	$340	22.9
Averages:	130	278	$7,918	$342	23.1

Annual Reduction in CO2-equivalent: 3,294 lb./building-year
0.51 lb./sq.ft.-year

Climate Zone 2: Net Zero TDV Energy
Large Single Family

Building Description	Total Annual KWh Saving	Total Annual Therms Saving	Incremental First Cost ($)	Annual Energy Cost Savings ($)	Simple Payback (Years)
7,500 sf (Option 1)	1568	378	$41,119	$1,467	28.0
7,500 sf (Option 2)	1582	378	$40,661	$1,470	27.7
Averages:	1575	378	$40,890	$1,468	27.8

Annual Reduction in CO2-equivalent: 7,089 lb./building-year
0.95 lb./sq.ft.-year

Climate Zone 3: Net Zero TDV Energy
Large Single Family

Building Description	Total Annual KWh Saving	Total Annual Therms Saving	Incremental First Cost ($)	Annual Energy Cost Savings ($)	Simple Payback (Years)
7,500 sf (Option 1)	212	375	$23,973	$849	28.3
7,500 sf (Option 2)	205	375	$25,420	$847	30.0
Averages:	209	375	$24,696	$848	29.1

Annual Reduction in CO2-equivalent: 5,449 lb./building-year
0.73 lb./sq.ft.-year

3.2 Low-rise Multi-family Building

Climate Zone 2: 15% Better Than Title 24
Low-rise Apartments

Building Description	Total Annual KWh Saving	Total Annual Therms Saving	Incremental First Cost ($)	Annual Energy Cost Savings ($)	Simple Payback (Years)
8,442 sf (Option 1)	1575	261	$8,089	$573	14.1
8,442 sf (Option 2)	1468	284	$6,388	$581	11.0
Averages:	1522	273	$7,238	$577	12.6

Annual Reduction in CO2-equivalent: 3,857 lb./building-year
0.10 lb./sq.ft.-year

Climate Zone 3: 15% Better Than Title 24
Low-rise Apartments

Building Description	Total Annual KWh Saving	Total Annual Therms Saving	Incremental First Cost ($)	Annual Energy Cost Savings ($)	Simple Payback (Years)
8,442 sf (Option 1)	363	318	$11,975	$428	27.9

Annual Reduction in CO2-equivalent: 3,865 lb./building-year
0.46 lb./sq.ft.-year

3.3 High-rise Multi-family Building

Climate Zone 2: 15% Better Than Title 24

High-rise Apartments

Building Description	Total Annual KWh Saving	Total Annual Therms Saving	Incremental First Cost ($)	Annual Energy Cost Savings ($)	Simple Payback (Years)
36,800 sf (Option 1)	14292	0	$30,160	$2,473	12.2
36,800 sf (Option 2)	9590	268	$87,428	$1,967	44.4
Averages:	11941	134	$58,794	$2,220	28.3

Annual Reduction in CO2-equivalent: 6,933 lb./building-year
0.19 lb./sq.ft.-year

Climate Zone 3: 15% Better Than Title 24

High-rise Apartments

Building Description	Total Annual KWh Saving	Total Annual Therms Saving	Incremental First Cost ($)	Annual Energy Cost Savings ($)	Simple Payback (Years)
36,800 sf (Option 1)	10032	179	$40,513	$1,941	20.9

Annual Reduction in CO2-equivalent: 6,598 lb./building-year
0.18 lb./sq.ft.-year

3.4 Nonresidential Buildings

Climate Zone 2: 15% Better Than Title 24

2-Story Office Building

Building Description	Total Annual KWh Saving	Total Annual Therms Saving	Incremental First Cost ($)	Annual Energy Cost Savings ($)	Simple Payback (Years)
21,160 sf (Option 1)	19085	-95	$56,100	$3,192	17.6
21,160 sf (Option 2)	15862	90	$60,572	$2,848	21.3
Averages:	17474	-3	$58,336	$3,020	19.4

Annual Reduction in CO2-equivalent: 7,834 lb./building-year
0.37 lb./sq.ft.-year

Climate Zone 3: 15% Better Than Title 24

2-Story Office Building

Building Description	Total Annual KWh Saving	Total Annual Therms Saving	Incremental First Cost ($)	Annual Energy Cost Savings ($)	Simple Payback (Years)
21,160 sf (Option 1)	19294	-75	$49,670	$3,252	15.3

Annual Reduction in CO2-equivalent: 7,809 lb./building-year
0.37 lb./sq.ft.-year

Climate Zone 2: 15% Better Than Title 24
5-Story Office Building

Building Description	Total Annual KWh Saving	Total Annual Therms Saving	Incremental First Cost ($)	Annual Energy Cost Savings ($)	Simple Payback (Years)
52,900 sf (Option 1)	40514	-506	$80,417	$6,427	12.5
52,900 sf (Option 2)	35774	-653	$39,917	$5,438	7.3
Averages:	38144	-580	$60,167	$5,932	9.9

Annual Reduction in CO2-equivalent: 10,419 lb./building-year
0.20 lb./sq.ft.-year

Climate Zone 3: 15% Better Than Title 24
5-Story Office Building

Building Description	Total Annual KWh Saving	Total Annual Therms Saving	Incremental First Cost ($)	Annual Energy Cost Savings ($)	Simple Payback (Years)
52,900 sf (Option 1)	47039	1450	$92,300	$9,805	9.4

Annual Reduction in CO2-equivalent: 38,046 lb./building-year
0.72 lb./sq.ft.-year

Conclusions

Regardless of the building design, occupancy profile and number of stories, the incremental improvement in overall annual energy performance of buildings under the Marin Green Building Ordinance and the 2008 Title 24 Building Energy Efficiency Standards appears cost-effective. However, each building's overall design, occupancy type and specific design choices may allow for a large range of incremental first cost and payback. As with simply meeting the requirements of the Title 24 energy standards, a permit applicant complying with the energy requirements of the Marin Green Building Ordinance should carefully analyze building energy performance to reduce incremental first cost and the payback for the required additional energy efficiency measures.